USING LEARNING ANALYTICS TO TRACK LEARNING PROCESS IN VIRTUAL MATH TEAMS (VMT) ONLINE ENVIRONMENT

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

USING LEARNING ANALYTICS TO TRACK LEARNING PROCESS IN VIRTUAL MATH TEAMS (VMT) ONLINE ENVIRONMENT

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The study has been conducted in the context of a graduate level Research Methods & Statistics course during 2013-2014 fall term in a large state university in Turkey. Aiming to introduce basic concepts of empirical research and experimental design, the course was structured in a way that the instruction was provided face-to-face and assignments were collaboratively completed online. There were 15 registered students in the course. Each registered student was assigned to a learning group and five teams were constructed in total. All teams were required to complete course assignments by collaboratively working online in a computer supported collaborative learning environment called Virtual Math Teams (VMT). For the solutions of the assignments, teams interacted in the chat environment and provided solutions as the wiki output.

In this study, we employ a socio-technical approach to analyze the collaborative learning process taking place in the VMT that offers chat and wiki features. More specifically, we explored the use of learning analytic methods to investigate learning groups' conceptual development in chat and wiki environments in the context of a semester long statistics course. We employed both quantitative and qualitative methods to analyze chat logs and

wiki outputs. For the analysis of chat logs, our approach consists of segmentation analysis to divide chat logs into segments, topic detection for identifying focus of segments, and interaction analysis of episodes for tracking learners' development of concepts. For the analysis of wiki content, we employed the content analysis and revealed the sufficiency of the content for the solution of the question. In addition, we compared the wiki content with the solutions proposed in the chat environment, hence explored the additions or removals in the finalized solution provided in the wiki environment.

Keywords: Computer Supported Collaborative Learning, Learning Analytics

ÖZ

VIRTUAL MATH TEAMS (VMT) ÇEVRİMİÇİ ORTAMINDAKİ ÖĞRENME SÜRECİNİN ÖĞRENME ANALİTİKLERİNİN KULLANILARAK DEĞERLENDİRİLMESİ

Afacan Adanır, Gülgün

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Bu çalışma, Türkiye'de bir üniversitede 2013-2014 güz yarıyılında yüksek lisans seviyesinde verilen Araştırma Yöntemleri ve İstatistik dersi kapsamında gerçekleştirilmiştir. Ampirik araştırma ve deney tasarımı ile ilgili temel kavramları anlatmayı hedefleyen bu derste öğretim yüzyüze verilmiş olup, ödevler ortaklaşa olarak çevrimiçi ortamda gerçekleşmiştir. Derse 15 öğrenci kayıt olmuştur. Her öğrenci bir gruba atanmış ve toplam 5 grup oluşturulmuştur. Tüm gruplardan ödevlerini bilgisayar destekli ortaklaşa öğrenme ortamı olan Virtual Math Teams(VMT) ortamında çevrimiçi ve ortak çalışarak tamamlanması istenmiştir. Ödevlerin çözümü için gruplar sohbet ortamında çalışmış ve cevaplarını wiki ortamında paylaşmışlardır.

Bu çalışmada, VMT ortamında gerçekleşen ortaklaşa öğrenme sürecinin analizi için sosyo-teknik yaklaşım kullanılmıştır. Detaylandırmak gerekirse, öğrenme analitikleri yöntemleri kullanılarak bir dönemlik istatistik dersinde öğrenci gruplarının sohbet ve wiki ortamlarında kavramsal gelişimleri araştırılmıştır. Nitel ve nicel yöntemler birlikte kullanılarak sohbet kayıtlarının ve wiki çıktılarının analizi gerçekleştirilmiştir. Sohbet kayıtlarının analizi

kapsamında, kayıtların bölümlere ayrılması için segmentasyon analizi, bölümlerin konularının belirlenmesi için konu tespit ve öğrencilerin kavram gelişiminin izlenmesi için etkileşim analizleri kullanılmıştır.Wiki içeriğinin analizi için içerik analizi kullanılarak, içeriğin soru cevabı için yeterliliği belirlenmiştir. Ayrıca, wiki içeriği sohbet ortamında bildirilen çözüm ile karşılaştırılmış, böylece wiki ortamında paylaşılan son çözümdeki ekleme ve çıkarmalar tespit edilmiştir.

Anahtar Kelimeler: Bilgisayar Destekli Ortaklaşa Öğrenme, Öğrenme Analitikleri

To My Husband and My Parents

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INTRODUCTION

1.1. Background of the Study

Classroom learning requires learning to take place in a teacher-centered learning context through face-to-face interaction in a live synchronous environment. Thanks to the recent advances in technology, traditional classrooms are no longer the only context for instruction. In other words, with the use of Information and Communication Technology (ICT), learning became possible even if students are remote from the teaching source. Online learning is regarded as a significant phenomenon since it supports learning with its unique characteristics. Ubiquitous (i.e. any-time and any-where) nature of online learning facilitates the accessibility of a learning program; hence learners can access the program at any convenient time and place. Various computer-mediated communication tools strengthen the interaction among instructors and learners, and facilitate collaboration within groups. In addition, online learning technologies address the needs of particular groups such as students or teachers living far away from schools as well as disabled students who have limited ICT access (Ardito et al., 2006).

Despite instructional benefits of online learning and the increasing number of online learners, students may become dissatisfied, and even drop out from online courses. One reason for this failure is that learners often feel isolated due to the insufficient level of communication with their teachers and peers (Willging & Johnson, 2009). Computer Supported Collaborative Learning (CSCL) is one form of online learning that also emerged as a reaction to most traditional educational settings where students learn in isolation by engaging with instructional materials by themselves. CSCL aims to offer new software and applications that connect learners, and support creative activities of intellectual exploration and social interaction (Stahl, Koschmann, & Suthers, 2006). While collaborating in a CSCL environment, learners use computer-mediated-communication (CMC) tools in order to communicate with their group members. CMC capabilities provided in CSCL environments can be categorized as either synchronous (e.g., via a chat facility or video conferencing), asynchronous (e.g., via a wiki, forum or e-mail), or a combination of both (Janssen, Erkensa, Kanselaara, & Jaspersa, 2007).

Measurement in CSCL aims to examine and summarize individual and group behaviors, from which researchers can make conclusions about learning products and processes (Gress, Fior, Hadwin, & Winne, 2010). Assessment in CSCL considers learner performance and comes in two different types; product or process assessment. Product assessment investigates learning outputs to understand whether a skill has been applied or a specific concept has

been learned. On the other hand, performance assessment analyzes learners' collaboration process instead of the final deliverable (Retalis, Petropoulou, & Lazakidou, 2010).

Learning is observed as a very interactive and dynamic process in CSCL environments. Thus, tracking how students collaborate in such environments is important to promote effective learning. According to the students' perspective, understanding what they have accomplished and what they need to do further leads to a more organized and efficient learning process. According the perspective of instructors, recognizing possible failures and offering immediate feedback to learners are noteworthy (Wang, 2009).

In an online learning environment, learners generally face with problems while trying to understand whether their work meets the requirements of the course. In a similar way, instructors experience difficulty in monitoring students' progress and recognizing situations where they should provide instructional support (Govaerts, Verbert, & Duval, 2011). Because learners are participating at-a-distance, instructors can not receive the kind of feedback from learners that they receive in a face-to-face classroom (Mattingly, Rice, & Berge, 2012). In recent years, methods appropriated from big data analytics have started to be employed for learning and education purposes. Increasing amount of data in education has led to the emergence of the 'Learning Analytics' research field, which is defined as "… the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" (Ferguson, 2012, p. 3).

Web analytics attempt to analyze and produce reports related to visits of web site users (Cooper, 2012). Large amount of data produced from different software applications lead to the realization of "big data" phenomenon. For example, in computer-supported learning masses of data can be acquired from various learner activities, such as online interaction in chat environment, taking role in discussion forums, solving exam questions and supplementary activities (Dyckhoff, Zielke, Bültmann, Chatti, & Schroeder, 2012). The Learning Analytics combines fundamentals of 'Web Analytics' and 'Big Data' areas, and considers obtaining data about learner actions and applying them to better investigate and enhance learning. For instance, learning analytics attempt to understand "how learners access the information, when they access the information, how they navigate through the materials, how long it takes for them to complete activities, and how they interact with the materials to transform the information into measurable learning" (Mattingly, et al., 2012, p. 239).

The collection of data and devising analytics to make sense of the trails left by learners is a fundamental concern in this emerging field. Such trails involve information on key aspects of learning such as information access and use practices learners follow, the social networks they form, the content of interactions they engage with, and the knowledge artifacts they construct in the course of their learning process. Educational data mining and analysis of learning interactions within socio-technical systems are dominant themes in the emerging field of learning analytics (Siemens, 2012; Scherer, Worsley, & Morency, 2012).

Educational Data Mining (EDM) focuses on devising predictive relationships among features extracted from learner logs to better inform instruction (Baker & Yacef, 2009; Romero & Ventura, 2007; Romero, Ventura, Pechenizkiy, & Baker, 2010). Automated discovery of learning needs and adapting learning resources to better cater to those needs are key components of the EDM approach. Typical EDM applications involve student modeling where successful as well as risky cases (e.g. a student who is likely to be dropping out) can

be automatically detected, and recommender systems that allow students to interact with personalized content based on predictions about their learning needs/styles inferred from their past history (Stamper et al., 2010; Manouselis, Drachsler, Verbert, & Duval, 2012). Such applications extend the assessment of learning outside individual courses and allow educators to monitor the progress of students as members of a larger learning community (Hung, Hsu, & Rice, 2012).

The socio-technical approach focuses on the content and the nature of the learning interactions mediated by learning environments as a systemic whole (Shum & Crick, 2012; Siemens, 2012). Building visualizations of social networks and studying the information flow within those networks with discourse analytic methods are of particular interest in this approach (Ferguson & Shum, 2011; Ferguson & Shum, 2012). Such tools are generally intended not only for research use, but also to support teachers' self-reflection on their teaching practice and to inform educational decision makers by providing a broader view of learning activities (Dyckhoff et al., 2012; Govaerts et al., 2012). Design of representations and analytic constructs that facilitate the coordinated analysis of learning traces distributed across individuals, collectivities and media in networked learning environments is another important thread in the socio-technical approach (Chu, Suthers, & Rosen, 2012). Such tools aim to bring the learning traces distributed across multiple media and sites together to enable the investigation of emergent learning phenomena within a learning community.

1.2. Statement of the Problem

An important advantage of CSCL environments is that they provide system logs that record details of the interactions experienced among students. Since these logs capture instances where learners ask questions, look for information and make reasoning together, they make the learning process visible to the instructors. The growing use of computer-mediated communication channels such as social networking, chat, instant messengers and wikis as component of CSCL applications has resulted in large repositories of such learning interactions. Although CSCL tools offer advantages to eliminate the student isolation issue, such environments also result in some methodological and pedagogical challenges. For example, tracking and analyzing all collaborative interactions of student teams is a time consuming task for instructors (Dascalu, Chioasca, & Trausan-Matu, 2008). Therefore, instructors tend to focus on learning outputs while evaluating learner performance in CSCL-environments. In this kind of evaluation, each team member is assumed to contribute equally to the final deliverable, and assigned the same grade. Yet, dividing students into groups and requiring them to collaborate do not simply result in equal participation and effective discussion. Thus, a detailed monitoring of the collaboration process is necessary to support teachers to perform a fair assessment of group work, provide learning activities in time and offer proper support when needed (Wang, 2009).

The majority of research on collaboration examines the quality of the final deliverable as a measure of success. On the other hand, researchers generally have paid inadequate attention to the collaboration process itself (Dillenbourg, 1999). Yet, assessment should provide support to enhance both the process and deliverables of the collaboration (Collazos et al., 2007). For example, learners have difficulty in understanding suitability of their contribution to a collaborative group due to the limitations related to CSCL applications. On the other hand, information about student actions can satisfy their awareness and meta-cognition, and as a result self-regulation of the learning activity (Daradoumis, Martínez-Monés, & Xhafa, 2006).

Design of collaborative scenarios taking place in CSCL and similar environments has been increasing to enhance learning among learning groups. As a result, great amounts of data are obtained from social learning platforms. However, it is essential for instructors to acquire proper data to evaluate changing behaviors and performance of learners in such collaborative environments. The learning analytics field attempts to help instructors by utilizing data mining methods to recognize learners' actions and present related information in the form of statistics and visualizations, so that instructors can monitor and assess the collaborative learning activities and make necessary adjustments to make them more effective for the students.

CSCL applications record details of learners' interactions that involve the contents of the messages and documents exchanged, they history of their correspondence(sending and reading timestamps, name of sender, name of readers, etc.) and log files (Pozzi, Manca, Persico, & Sarti, 2007). Related to the data collection, log files can be analyzed to support instructors' assessment of the collaboration processes. In addition, learners can be immediately informed about the consequences of the analysis to stimulate their awareness and reflection on their group work (Nurmela, Lehtinen, & Palonen, 1999). The results acquired from monitoring and analysis of collaboration processes can serve three major goals. Firstly, a data informed assessment of the instructional design and the learning environment can be used to improve the value of the course enriched with a CSCL environment. Secondly, tracking learner performance allows instructors to provide their learners with appropriate support and feedback. Thirdly, performing formative and summative assessment of student performance may become possible (Pozzi et al., 2007).The Learning Analytics methods aim to collect and analyze data about learner actions in order to better characterize and improve learning through fully or semi-automated data mining algorithms. Utilization of learning analytics methods in CSCL is a promising approach for the assessment of the effectiveness of the collaborative learning activities taking place in CSCL environments.

1.3. Purpose of the Study

The aim of this study is to investigate the use of learning analytics methods to inform the analysis of knowledge building processes mediated by a CSCL environment called Virtual Math Teams (VMT) that provide multiple interaction spaces including chat, whiteboard and wiki components (Stahl, 2009). VMT provides a chat function to support collaboration among learners at the small group level and a wiki component to facilitate knowledge sharing at the community (e.g. classroom) level. In the chat setting, team members engage with various types of activities that are of social, coordinative, and content related nature. Our focus is on excerpts containing content related discussions which reflect the groups' collaborative learning efforts in the targeted educational domain. These excerpts will also inform us about the concepts teams discuss about. Within these excerpts, we aim to capture learners' progress regarding these concepts and provide appropriate learning analytics. In addition, we are interested in reflections of learners' collaboration on the wiki environment. The following research questions are attempted to be addressed through this study:

1) Which segments of chat logs reflect learners' collaborative studies on assignments?

2) Which target concepts are discussed within the task-relevant segments of chat logs?

3) How learners accomplish conceptual development during their collaborative study in chat environments?

4) How are the contents of chat discussions and wiki postings relate to each other?

5) How are the process measures devised by learning analytics methods and the measures for overall learning outcomes relate to each other?

1.4. Significance of the Study

In the context of a course, instructors can assign homework via VMT which enables students to work in groups to share their ideas and understandings to collaboratively seek for solutions to the questions. While chatting online, learners benefit from the shared Whiteboard or the GeoGebra board to explain their ideas through drawing functionalities. The group work can continue with learners' sharing of their solutions over the Internet. VMT supports this kind of online publication process by offering a Wiki component. Learners can insert appropriate text and images in order to reflect their solutions as a Wiki document. In this way, instructors can view the product of the online collaboration and conduct corresponding evaluations. However, the final product does not necessarily communicate to instructors the details of the collaboration process that lead to the production of the final outcome. That is, assessing only the learning product hinders each participant's progress during the collaborative work. Therefore, instructors should know about learner activities, especially their conceptual development in chat and wiki environments in order to achieve a complete assessment of online collaboration.

VMT produces detailed recordings including chat logs and wiki history to support the instructors for reviewing learners' collaboration. However, analyzing such a large amount of data is a time intensive task for the instructors. When we consider the additional duties of the instructors, expecting them to do a thorough data analysis of all groups becomes infeasible. Since analyzing interactions of learners in CSCL-environment is a time consuming task, the instructors tend to neglect the collaboration process and consider only the final deliverables while evaluating learner performance. Therefore, instructors need analytics, particularly related to the process of collaboration that took place both in chat and wiki environments to inform their assessment of the learning activities.

In these respects, the goal of this study is to cater to the practical needs of the instructors mentioned above. To be more specific, this study aims to provide learning analytics that will help instructors assess the learning process by capturing learners' conceptual development during the chat activity and the reflection of these activities to the outcome (i.e. the Wiki output) co-constructed after the collaboration.

The methods developed in this study provides instructors with indicators and tools for exploring and analyzing learners' task related discussions in the chat environment. More specifically, the method identifies the parts of students' discussions in which learning groups collaboratively worked on solving questions of the assignments for the course. The study attempts to find the topics of discussion parts by applying appropriate text mining methods. These discussion parts point to different questions of the assignment. By understanding the topics of discussion parts, instructors can understand which question is discussed in which part of the chat discussion. In this way, instructors can review the specific part in order to understand learners' discussions according to the specific question of the assignment. In these discussion parts, learners' conceptual developments were analyzed in order to provide

instructors with understanding of learners' construction of knowledge through the interaction of their group members.

Additionally, the study identifies the intersection and difference among chat content and wiki output for each question of the assignment. This study aims to address the lack of assessment functionality in VMT environment. We will generate and provide learning analytics that aim to explore interaction between learners' discussions and corresponding wiki content from the perspective of learning analytics. That is, we will explore the relationship among learning activities that take place in synchronous (chat) and asynchronous (wiki) collaborative learning modalities. At the same time, we will focus on how chat content is used for summarization activity. We expect that summarization activity in the wiki environment will have positive impact on students' chat discussion and learning, since producing wiki summaries will encourage them to reflect on the ideas discussed during chat.

To our knowledge, existing studies that applied learning analytics have focused on the performance of learners in a single online learning environment. In contrast, this study focuses on learner contributions in two different learning environments (chat and wiki) together with the relationship between the collaborative activities mediated by these environments and the learning outcomes. From these aspects, our study is an attempt to cater to the need stated in the related literature for developing analytics that run across multiple interaction spaces in the context of a semester long course.

1.5. Thesis Outline

The remainder of the thesis is organized as follows. In Chapter 2, we presented a review of related literature review, including an overview of computer supported collaborative learning (CSCL), learning analytics, topic detection in CSCL, and knowledge building theory. We dedicated the Chapter 3 for the methodology. In this chapter, we presented the theoretical model, data collection and analysis steps. We provided the findings of the thesis in Chapter4. In Chapter 5, we presented the summary and implications of the results for researchers and practitioners. In this chapter, we additionally discussed the limitations and the assumptions of the study, as well as reliability and validity issues.

CHAPTER-2

LITERATURE REVIEW

2.1. Computer Supported Collaborative Learning (CSCL)

In today's world, professions tend to be increasingly more knowledge-based, interdisciplinary and complicated; hence it has become much more challenging for individuals to accomplish a task without soliciting help from others (Wang, 2009). Although face-to-face collaboration is possible, computers and the Internet offer important affordances for facilitating the collaboration of individuals, especially of students, in more effective ways. Researchers have recently started to investigate the possibility of using ICT applications to support and investigate collaborative learning, which led to the emergence of Computer Supported Collaborative Learning (CSCL) field in late 1980s. The CSCL term was initially used at an international workshop in 1989 in Maratea, Italy. The first international CSCL conference was held in 1995, and then subsequent CSCL conferences have been organized in Europe, North America and Asia, which gradually increased the size of the CSCL community as a specialized area within learning sciences. In 2006, the International Journal of Computer supported Collaborative Learning (ijCSCL) had its initial issue published (Ludvigsen & Mørch, 2009), which has become the major outlet for CSCL research along with the Journal of the Learning Sciences and Computers & Education.

The CSCL area is based on social learning theories which propose that knowledge is resulted from learners' interaction, knowledge sharing, and knowledge building as a community. Two major theoretical perspectives for characterizing learning in a CSCL context draw from theories of Piaget and Vygotsky. According to the Piagetian socio-cognitive conflict theory, learners at diverse stages of cognitive development or learners in the same level of cognitive development but having different perspectives may experience growth by experiencing and overcoming cognitive conflict during social interaction and collaborative activities. This kind of cognitive conflict results in the development of new conceptual forms and understanding in learners' minds through a process called accommodation (Tudge & Rogoff, 1999). According to Vygotsky's social learning theory, individuals can gain knowledge through their interaction with more capable peers in a CSCL environment. The other key element provided by Vygotsky is the notion of zone of proximal development, which proposes that learners acquire new concepts by first engaging with them in a social setting with the support of more skilled learners or instructors (Lipponen, 2002).

Learners employ various computer-mediated-communication (CMC) technologies in order to communicate with their group members in a CSCL environment. CMC capabilities offered in such an environment can be categorized as either synchronous (e.g., via a chat

facility or video conferencing), asynchronous (e.g., via a wiki, forum or e-mail), or a combination of both (Janssen et al., 2007).

CSCL environments have been typically evaluated in terms of educational, motivational and social aspects. For instance, the study of Francescato et al. (2006) compared the effectiveness of collaborative learning between online and face-to-face groups. According to the results, no significant difference was found in terms of learners' professional knowledge levels. Eales, Hall, and Bannon (2002) compared CSCL in different settings – workplace, schools, and universities- and found CSCL to be useful in promoting learners' motivation for learning and exploration in each of these settings. Since learning groups are created in CSCL-environments, increase in social interaction and knowledge sharing are also potential outcomes of CSCL. Learners may benefit from CSCL in various ways. Petropoulou et al. (2010, p. 232) have listed the advantages of CSCL as follows:

- "opportunities for participants to share their knowledge and expertise;
- opportunities for participants to discuss, plan, reflect on and explore learning issues;
- increased inspiration, innovation and motivation amongst participants;
- increased social contact between individuals having different backgrounds;
- a reduction in feelings of isolation (both geographically and emotionally);
- increased access to shared resources."

CSCL is considered as "an emerging branch of the learning sciences concerned with studying how people can learn together with the help of computers" (Stahl et al., 2006). CSCL is employed in all stages of formal education from pre-school to graduate level as well as informal education. As in other instructional activities, instructors are suggested to follow some specific practices and strategies while using CSCL. Common techniques are identified as discussion, jigsaw approach, peer review, role play, and case study (Pozzi & Sugliano, 2006). The discussion component can be structured either in an open-ended manner or maybe carried out in two phases. In the first phase, learners individually study some learning materials, whereas the second phase is allocated for the collaborative study of learners based on what they learned in the previous phase. The jigsaw approach considers segmenting the content into sub-topics and assigning each topic to a different learning group or individual. With the help of collaboration, each learning group or individual master the whole topic by combining the knowledge elements and producing learning artifacts on the basis of their topic content. Role play allows learners to gain understanding through critical reflection on real situations by enacting different perspectives and generally consists of three phases. In the first phase, team members are assigned different roles, in the second phase students interact with each other by performing their roles, and in the final phase groups carry out a discussion in order to interpret the results of their collaborative work. Finally, the case study approach involves collaborative activities where students are given in-depth materials for a specific case (e.g. information about a disease observed in an island and possible known causes) and asked to analyze it, develop hypotheses about causal relationships, identify strengths and weaknesses in the presented arguments, and work towards a plausible explanation through collaboration and argumentation.

Measurement in CSCL aims to examine and summarize individual and group behaviors, from which researchers can make conclusions about learning products and processes (Gress et al., 2010). Assessment in CSCL considers learner performance and comes with two different types; product or process assessment. Product assessment investigates learning outputs to understand whether a skill has been applied or a specific concept has been learned.

On the other hand, performance assessment analyzes learners' collaboration process instead of the final deliverable (Retalis et al., 2010).

The results obtained from tracking and analysis of learning processes can serve various purposes. In this regard, Pozzi et al. (2007) have proposed three main benefits. Firstly, evaluating the quality of instructional design and the learning environment is important to improve the success of the course enriched with a CSCL environment. Secondly, monitoring learner performance helps instructors to provide appropriate support for the students. Thirdly, assessing individual learning processes and conducting formative and summative assessment of student performance may become possible based on the data accumulated in CSCL environments.

Learning is observed as a very interactive and dynamic process in CSCL environments. Thus, tracking how students collaborate in such environments becomes a significant issue for promoting effective learning. According to the students' perspective, understanding what they have accomplished and what they need to do further often leads to a more organized and efficient learning process. From the perspective of instructors, recognizing possible failures and offering immediate feedback to remedy such issues are important for facilitating fruitful collaboration (Wang, 2009). In addition, social loafing and free riding problems that may arise in CSCL activities can be eliminated or reduced with the help of measurement and assessment mechanisms. Social loafing occurs when learners allocate little effort in group tasks due to their belief that their input will not matter for the team, which hinder their participation in collaborative work. Free riding refers to the case where some members in the team do not contribute to the group work, and take advantage of the efforts of remaining members. If undetected, free riding students may unfairly obtain the same grades with members accomplishing the real group work. In general, it is vital to promote learners' balanced participation in CSCL activities. To serve this purpose, some strategies have been recommended. Firstly, integrating positive interdependence and individual accountability to the group task is an important strategy to increase the motivation for participation. Positive interdependence refers to promoting learners' understanding and awareness that they should work together to reach to their shared goal. Individual accountability means that each member in the group is respected as responsible for their contribution to the group's shared goal. Moreover, visualizing each learner's contribution to group work is another strategy to increase participation in CSCL through motivational and feedback processes (Janssen et al., 2007). The effectiveness of these strategies relies on robust analytics that provide an accurate account of collaborating groups' activities.

2.2. Learning Analytics

The Learning Analytics area originates from 'Big Data' and 'Web Analytics', and focuses on collecting data about learner actions and using them to better understand and improve learning. The "big data" phenomenon represents the large amount of data produced with the use of various information and communication technologies. From the perspective of education, the extensive use of Learning Management Systems (LMS) such as Moodle and Blackboard require educational institutions to seek effective strategies to cope with and take advantage of increasing volumes of educational data (Ferguson, 2012). For instance, in computer-supported instruction, masses of data can be obtained from various student actions, such as completing assignments, entering exams, online group interaction, participating in online forums, and even extracurricular activities (Dyckhoff et al., 2012).

Web Analytics aim to analyze and report on web visits of users (Cooper, 2012). The goals of Web Analytics are improving the performance of web sites, enhancing user experience, and detecting issues that need revisions at the design and implementation stage (Retalis, Petropoulou, & Lazakidou, 2006). Two categories of Web Analytics are identified as "on-site" and "off-site". On-site analytics attempt to reveal user activities such as visited pages, time and duration of visits, geographical locations and searched terms. On the other hand, off-site analytics focus on product or service related activity that happen in any site on the web. For instance, comments on products or effects of advertisements are potential considerations (Cooper, 2012). Since CSCL systems often involve web based interfaces, web analytics tools also offer important opportunities for collecting analytics related to learning activities.

According to the definition contributed by the recently established Society for Learning Analytics Research, Learning Analytics is concerned with the measurement, collection, analysis and reporting of data about learners and their contexts of learning, for the purpose of understanding and optimizing learning and the environments in which it occurs (Siemens & Gasevic, 2012). In addition, researchers have proposed similar definitions for Learning Analytics (van Barneveld, Arnold, & Campbell, 2012) such as;

- "The application of analytic techniques to analyze educational data, including data about learner and teacher activities, to identify patterns of behavior and provide actionable information to improve learning and learning-related activities" (van Harmelen & Workman, 2012, p. 5).
- "The interpretation of a wide range of data produced by and gathered on behalf of students in order to assess academic progress, predict future performance, and spot potential issues" (Johnson, Smith, Willis, Levine, & Haywood, 2011, p. 28).
- "The use of predictive modeling and other advanced analytic techniques to help target instructional, curricular, and support resources to support the achievement of specific learning goals" (Bach, 2010, p. 2).
- "The collection and analysis of usage data associated with student learning; to observe and understand learning behaviors in order to enable appropriate intervention" (Brown, 2011, p. 1).

Learning analytics attempt to supply answers to various questions which can be categorized under two broad categories, namely (1) questions related to information and fact, and (2) questions related to understanding and insight (Cooper, 2012).

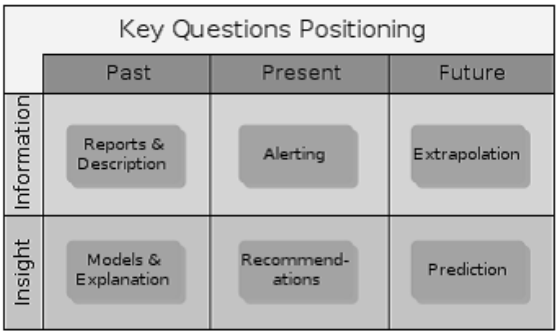

Figure 1. Key Questions of Analytics (Cooper, 2012, p. 4)

Cooper (2012) summarized the questions addressed by Learning Analytics in the following way. First of all, analytics focused on the past, therefore report findings and provides a

summarized description of data. In order to satisfy a deep understanding and insight about the actions happened in the past, analytics generates appropriate models and explanations. The present actions are also significant from the viewpoint of analytics. This leads to production of the alerts for the present. At the same time, analytics recommend one or more choices as the most appropriate set of actions for the present situation. By considering the inferences of the past, the analytics can predict the future trend. For this purpose, analytics aim to generate predictions, explain the consequences of different courses of action, or suggest the most appropriate course of action. The categorization of these questions maps to the levels of analytics proposed by the SAS (Statistical Analysis System).

Table 1 Levels of Analytics (SAS, 2008, p. 2-3)

Levels	For Answering Questions like
Standard Report	What happened? When did it happen?
Ad Hoc Reports	How many? How often? Where?
Query Drilldown/OLAP	Where exactly is the problem? How do I find the answers?
Alerts	When should I react? What actions are needed now?
Statistical Analysis	Why is this happening? What opportunities am I missing?
Forecasting	What if these trends continue? How much is needed? When will it be needed?
Predictive Modeling	What will happen next? How will it affect my business?
Optimization	How do we do things better? What is the best decision for a complex problem?

The information provided by Learning Analytics can be utilized to inform institutions, teachers, learners or parents. For the use of instructors, basic analytics can be generated about the actions of students such as what activities they are performing, in which activities they are allocating the time, which content they are accessing to (Brown, 2011). An individual learner's activity can be compared to other students in the class or to the ones that had taken the course in previous terms. Additionally, learner products can be compared according to the previously constructed rubrics (Diaz & Brown, 2012). Learning Analytics additionally produce analytics for the following objectives (vanHarmelen & Workman, 2012): detecting students who are at risk and offering positive interventions that can enhance their retention; providing suggestions for students such as reading sources and learning activities; analyzing educational needs, and assessing outcomes of educational improvements, altering course offerings; identifying teachers doing well, and ones who need help while applying instructional methods; and supporting learner recruitment process.

2.2.1. The Learning Analytics Cycle

As the Figure 2 demonstrates, the Learning Analytics Cycle consists of four major steps: learners, data, metrics, and interventions (Clow, 2012, p.134).

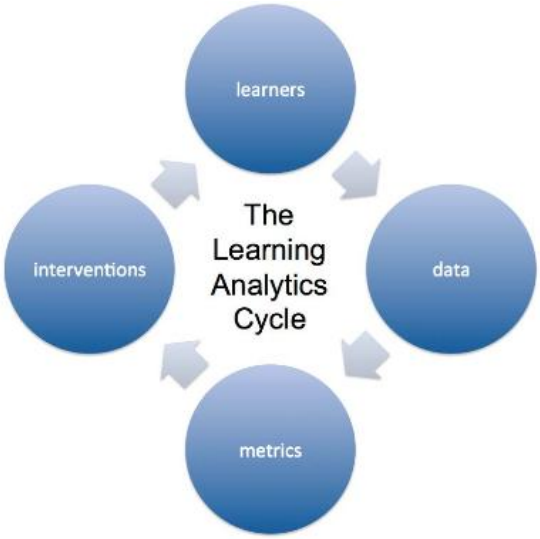

Figure 2. Learning Analytics Cycle (Clow, 2012, p. 134)

Step-1 Learners: Learning Analytics aim to analyze data of various types of learners such as students registered to a course in a university, learners registered to an online course, participants at a conference or casual learners searching Open Educational Resources.
Step-2 Data: According to the type of learners, Learning Analytics generate and capture appropriate data such as demographic information; login and clickstream data produced in a computer supported learning environment; forum postings; evaluation results or alumni status.
Step-3 Metrics: The cycle of Learning Analytics continues with transformation of data to metrics or analytics in order to summarize the learning process to aid interpretation and decision making. These transformations consist of visualizations, dashboards, lists of students at risk, assessment of outcome measures, aggregations, etc.
Step-4 Intervention: The last step of Learning Analytics attempts to interpret the learning process to take appropriate actions or interventions. For instance, a dashboard can be generated to compare learners with their peers in terms of their activities in the online learning environment. Instructors can also communicate with a student who is at risk of dropping of out.

2.2.2. Types of Data

According to Diaz and Brown (2012), Learning Analytics applications tend to focus on two different types of data. The first type is generated when learners participate in activities related with particular courses. The second type is learner profile information extracted from instructional applications such as students' former coursework, demographic information, and other relevant data that may exist in the learning management system.

Although the majority of the data generated in educational institutions is saved in protected formats, researchers have initiated a call for opening up educational data repositories for research purposes. In this respect, two categories of data are identified as protected and open data (Drachsler & Greller, 2012). Expected benefits may not be obtained because of constraints or possible limitations. Applying learning analytics in educational datasets brings new ethical and privacy issues. Therefore, appropriate policies and guidelines should be proposed to use data in a proper way and prevent data from being misused. Authorized data

and privacy protection might encourage subjects to provide their precise and informed consent. In addition, subjects may be required to opt-in or opt-out for data collection activities. To summarize, while applying Learning Analytics, the following ethical issues need to be considered (Bach, 2010, p. 4):

- Which data should be collected and not collected about students?
- Who is allowed to access the data and observe the results?
- Which data is appropriate for anonymous reporting?
- Which data will serve educational needs?
- What is the effect of demonstrating outputs of faculty modeling? Are there any data that bias instruction and assessment of learners?

2.2.3. Learning Analysis Techniques and Related Fields

After the collection of data, the cycle of Learning Analytics continues with transformation of data to metrics or analytics in order to create an understanding about the learning process. During this process, learning analytics benefit from various technologies such as 'educational data mining', 'machine learning', 'statistical analysis', 'information visualization', and 'simulations'.

Analytics in education are divided into three subfields as "Learning Analytics', "Educational Data Mining", and "Academic Analytics" in terms of the challenges they consider. The major focus of learning analytics is on the educational challenge, hence attempts to provide opportunities for learning. Educational data mining focuses on the technical challenge and aims to derive value from big collections of learning-related data. For this purpose, it aims to develop algorithms that identify patterns in learners' activities and guide them towards the right direction. By focusing on economic/political challenges, the academic analytics aim to enhance educational opportunities and outcomes at national and international levels (Ferguson, 2012). Academic analytics assist instutions in accomplishing their missions. For instance, it can be applied while choosing candidates among applicants who desire to study in a specific programme (van Harmelen & Workman, 2012). On the other hand, learning analytics is more specific and concentrate on the learning process (such as the relationship between students, content, institutions, and instructors).

Machine learning considers discovery of patterns in data by employing computer algorithms. Supervised machine learning considers characteristics of prior data to predict the consequence of new situation. On the other hand, unsupervised machine learning identifies the patterns in data without considering any previous knowledge.

Statistical methods are critical solutions for most of the analytics problems. Statistical methods can be considered in two different types; descriptive and inferential statistics. Descriptive statistics deal with measures of central tendency (e.g. mean, median), measures of dispersion (e.g. standard deviation, interquartile range), measures for capturing structural properties of social networks (e.g. betweenness centrality), and time related measures. Inferential statistics consist of hypothesis testing, correlation or regression analysis, with the aim to generalize statistics obtained from specific samples to relevant populations.

Information visualization provides visual representation of both non-numerical and numerical information (Cooper, 2012) in order to increase learners' self-reflection and awareness related to their learning process (Duval & Verbert, 2012).Simulations are employed to understand the emergent associations between systems and their components.

Simulations can be also applied to test the implications of specific factors in the future by executing what-if scenarios, provided that cause and effect relationships are available.

The Learning Analytics field acquires and combines methods of diverse related areas, such as Academic Analytics, Educational Data Mining, Social Network Analysis, or Business Intelligence (BI) (Dyckhoff et al., 2012). All of these fields consider the collection of large amounts of data to detect patterns by using data mining and machine learning techniques. With the help of the detected patterns, crucial suggestions can be provided for resources, activities, people, etc. (Duval & Verbert, 2012).

2.3. Methods Used for Learning Analytics of CSCL Environments

The significant advantage offered by CSCL environments is the system logs that capture the interactions among students. For instance, CSCL applications automatically record learner data that consist of messages and documents exchanged, the corresponding history (e.g. sending and reading timestamps, name of sender, name of readers, etc.) as log files (Pozzi et al., 2007).

In order to investigate log files, researchers can apply either qualitative or quantitative analysis. While performing quantitative analysis in manual ways, log entries are transformed to particular measures. Yet, appropriate software can be developed to conduct that transformation in automated ways. Type of analysis can be selected in parallel to the nature of the research (Bruckman, 2006). One type of research may aim to measure learner engagement in CSCL environments and generally focuses on quantitative indicators (Fournier, Kop, & Sitlia, 2011). For instance, researchers have considered learners' number of page accesses, time-on-task, resource use, as well as the number of the messages read, the postings made to a discussion board, and the frequency of the file up-loads (Retalis et al., 2006).

Although a researcher can perform qualitative log file analysis by interpreting logs, automated tools can support this process as well. For instance, software applications are useful for the organization of large amount of data from which researchers can extract meaningful information. For the qualitative analysis of log files, different frameworks can be employed such as grounded theory (Glaser & Strauss, 1967), and activity theory (Engeström, Miettinen, & Punamäki, 1999). In addition to content analysis of log files, surveys and interviews made with participants are additional methods that can be employed for gaining further insights about collaborative learning (Bruckman, 2006).

In addition to the analysis of log files, investigating the structure and the organization of collaborative processes are important goals in the field of CSCL. Therefore, for the purpose of assessing collaborative processes mediated by chat environments, researchers employ various methods such as social network analysis, discourse analysis, and content analysis (Li, Wang, Liao, Zhao, & Huang, 2007), which are further described in subsequent sections.

2.3.1. Social Network Analysis

Social network analysis (SNA) has recently become a popular assessment method for analyzing the structure of collaborative interactions in CSCL. SNA is defined as "the mapping and measuring of relationships and flows between people, groups, organizations, computers, URLs, and other connected information/knowledge entities" (Mukherjee &

Holder, 2004, p. 2). In general, SNA investigates dynamics of the learner network. While analyzing interactions in CSCL environments, SNA attempts to find out who collaborate with whom and who are the most active learners in collaboration. SNA represents the results of these and similar questions with the help of graph theoretic constructs such as in-degree, out-degree, centrality, and eigenvalue metrics. In-degree is defined as the number of chat utterances received by the learner. Out-degree indicates the number of chat utterances provided from one learner to others in the learning environment. The degree of centrality of a learner is calculated according to the largest value of in-degree and out-degree metrics. In the domain of graph theory and network analysis, there are several measures of the centrality of a vertex within a graph that indicate the relative significance of a vertex in the graph (for example, how important an individual is in a social network, or, in the theory of space syntax, how important a room is in a building or how well-used a way is in a city network) (Passmore, 2011). The eigenvalue metric is applied to reveal the significance of the learners in the network.

Several recent CSCL studies have employed the SNA metrics to investigate the structure of collaborative interactions mediated by CSCL environments. For instance, An Advanced System for Assessing Chat Participants (ASAP) study is one of the early studies using SNA methods in CSCL. The ASAP study initially focuses on chat preprocessing by using the Jazzy library to eliminate issues such as spelling errors, abbreviations and emoticons for further analysis. Additionally, the researchers employed methods for eliminating the stop words and performing a stemming process where words are reduced to their stems to capture the basic semantic content of the chat messages (Dascalu et al., 2008). After the data preprocessing, a ranking process and the methods of social network analysis are applied to the chat data. By using the Google Page Rank algorithm, the study calculates the ranking for each learner based on the number of interventions exchanged among learners and the score of utterances. The study also takes into consideration social network analysis to identify the in-degree, out-degree, centrality, and eigenvalues metrics for the chat logs.

Social networks adapting pedagogical practice (SNAPP) was developed as a monitoring/diagnostic tool that enables instructors to assess the behavior of a learning network and to decide whether it is consistent with previously constructed learning activity goals. SNAPP supports basic social network analysis tools to investigate the learners' interactions in discussion forums provided in learning management systems (LMS) such as Moodle, Blackboard and Desire2Learn (Bakharia, Heathcote, & Dawson, 2009). The SNAPP tool attempts to detect the patterns of relationship among the learners based on the links between their postings in a threaded discussion board and creates a social network diagram. Visualization of the social network can be filtered according to different learner activities. The social network diagrams can be used for identifying isolated students, patterns of instructor centered networks, group malfunctioning, and learners connecting small clustered networks and taking the role of information brokers.

The Participation Tool (PT) was integrated to a CSCL-environment in order to visualize the contribution of learners to their group's online communication (Janssen et al., 2007). The PT provides visualizations on quantitative indicators like the number and the length of messages sent by the individuals and groups. Moreover, the PT analyzes learners' task related, social, coordinating/regulating, and technical activities, which are summarized as follows. Learners in a group perform task-related activities while collaboratively solving a given problem. Social elements of the collaboration are revealed due to the groups' member-support and well-being functions. More specifically, a positive atmosphere in a group is expected to

enhance the learners' efforts to accomplish a task. Coordination and regulation of activities are applied to satisfy a common course of action during collaboration. Technical activities are performed to manage software related challenges in the collaborative learning environment.

The LMSAnalytics tool has been developed for instructors' use in assessing performance of individuals and groups in a networked learning environment (NLE) (Petropoulou et al., 2010). The LMSAnalytics automatically analyzes and visualizes data that are collected during networked collaborative learning processes. By using the tool, instructors can evaluate the learners' behavior in a collaborative environment and provide immediate support when needed. In order to analyze learner behaviors in NLE, the study has proposed a multi-faced framework that employs different approaches such as descriptive statistics, social network analysis, as well as content and context analysis. The framework of the study focuses on two dimensions to assess learner performance in NLE such as the quality of learning products, and the quality of collaboration. In order to conduct a deep analysis, four types of interaction have been covered which are categorized as learner–content, instructor–learner, learner–technology and learner–learner. The first axis of the framework focuses on the quality of all deliverables accomplished by individuals or groups. The quality of the learning products is assessed with the help of quantitative and qualitative indicators. The second axis concerns the effects of interactions in an NLE for constructing learning products. The framework proposes that interactions between peers, learner-tutor and learner-content need to be considered to get a general overview of the collaborative learning activities mediated by the CSCL system.

2.3.2. Discourse Analysis

Discourse analysis focuses on the study of language as a means for knowledge construction. In the CSCL context, discourse analysis is mainly used to investigate the linguistic structures used by the learners to coordinate and organize their interaction during collaborative activities. Such methods employ theoretical frameworks such as speech-act theory (Searle, 1969) and dialogism (Bakhtin, 1986) in an effort to capture the specific communicative and coordinative functions of relevant linguistic units within knowledge building discourse. Once operational formalisms or categorizations can be made, such structures also serve as important resources for automated or semi-automated approaches to discourse analysis in CSCL.

One of the first automated procedures for coding dialogue acts was developed by Erkens and Janssen (2008) in the CSCL literature. In this approach, the aim is to identify communicative function of chat messages with the help of discourse markers and cue phrases in the utterances. Five major communicative functions are defined as argumentative, responsive, informative, elicitative, and imperative. Argumentative dialog acts refer to a sequence of argumentation or reasoning statements; responsive dialog acts consist of confirmations, denials, and answers; informative dialog acts indicate information transfer among group members; elicitative dialog acts cover questions or offers that require answers; and imperative dialog acts represent commands or directives made by the participants. Erkens and Janssen (2008) approach aims to classify each chat or dialogue utterance by using a rule-based algorithm that uses specific keywords and sentence structures indicative of each communicative function.

The study developed by Gweon, Raj and Rose (2011) attempts to detect utterances in which learners conduct "reasoning" in their group discussions. Initially, the method identifies the segments that have content related to reasoning. Then, each of these segments is categorized as one of 5 different types such as theoretical concepts, prior knowledge, physical system properties, emergent system properties, and goals. Moreover, the study attempts to categorize the reasoning process into different groups. Firstly, two kinds of relationships are detected to indicate a reasoning process such as compare/contrast and cause/effect. Secondly, statements are categorized as externalizations or transactivity. Externalizations refer to the statements that lead to a new route in the conversation, whereas transactive statements are based on previous contributions, which indicate progressivity in interaction. The results of the study suggested that above chance classification accuracy can be obtained for detecting utterances related to reasoning and transactivity by using machine learning methods.

In Weinberger and Fischer (2006)'s study, a multi-dimensional framework has been presented to analyze argumentative knowledge construction in CSCL environments. The framework consists of (1) the participation dimension, (2) the epistemic dimension, (3) the argument dimension, and (4) the dimension of social modes of co-construction. The participation dimension aims to analyze the learners' level of contributions to collaborative work. For this purpose, the quantity and the heterogeneity of learner's participation are considered by the methodology. The quantity of participation indicates the extent learners contribute to the discourse. The heterogeneity of participation is expected to below, indicating that all learners contribute at a similar level to collaborative work. The epistemic dimension analyzes contributions from a qualitative perspective. That is, the content of discourse is investigated to understand whether it is related to activities for solving the task or not. The construction of a problem space indicates understanding the expectations of the problem. That is, the construction of the conceptual space consists of how learners summarize, rephrase and discuss relevant theoretical concepts and principles. Additionally, the epistemic dimension considers the relations between the conceptual space and the problem space. The argument dimension focuses on learners' construction and balance of arguments and counterarguments to solve complex problems. Claims refer to statements which enhance the position of learners. Grounds provide a basis for the validity of claims and represent evidences such as observations and experiences. On the other hand, qualifiers indicate statements that constrain the claim's validity to some situations. The social modes of co-construction describe the degree that learners specify contributions of their learning partners. Externalization indicates learners' contributions to discourse without providing any reference to previous contributions. Elicitation means receiving information from other group members by asking related questions. Quick consensus building occurs when learners accept a proposal from a group member not because they are fully convinced but they are willing to continue the discussion without disrupting the progress of the activity. Integration-oriented consensus building considers individual learners' functioning based on reasoning of other group members. As its name implies, conflict-oriented consensus building is observed when learners eliminate or change some aspects of contributions of their peers, or when they offer alternatives. In short, Weinberger and Fischer (2006) contributed a comprehensive framework for categorizing discourse elements in terms of their epistemic and collaborative functions. However, the framework was not transformed into an automated application with the help of machine learning methods.

2.3.3. Content Analysis

Content analysis adopts a qualitative perspective in analyzing collaborative learning processes. The purpose of content analysis is to investigate learner contributions in online discussion environments, and to identify the type of each contribution (Fournier et al., 2011). Similar to discourse analysis, content analysis also focuses on devising categorization schemes to analyze linguistic content, but it also covers the contents of graphical and other narrative resources.

In their study, Retalis et al. (2006) aims to obtain data related to learners' behaviors of access. The initial step of analysis is to create an overall view of log entries and to generate usage statistics like visit counts and the average time allocated for conducting an activity. Additionally, the approach aims to perform a path analysis by forming clusters of learners who conduct similar types of activities in one or more online sessions. For instance, a group of learners having similar browsing behaviors can be generated. The approach offers a tool called CoSyLMSAnalytics to analyze the activities of learners in the Moodle LMS. The approach produces quantitative analysis results such as the number of postings per learner, the number of replies, as well as the categories of posted messages. In addition, it tries to identify when groups talk about concepts or procedures to complete the task, and whether groups achieve the task collaboratively or cooperatively.

Automatic Classification of Online Discussions with Extracted Attributes (ACODEA) framework has been proposed for automatic analysis of online discussions (Mu, Stegmann, Mayfield, Rosé, & Fischer, 2012). The framework consists of three major layers: (1) Extracting attributes, (2) Segmenting, (3) Coding. In the first layer, a part-of-speech tagger and a named entity recognition system are employed separately. The purpose of this step is to detect textual features that are important for making significant patterns recognizable to machine learning algorithms, and to produce models that generalize in a sound way. Instead of using previously developed categories, the study has created its own set of labels to categorize tasks and intended activities. The Segmenting layer requires human coders to preprocess the data initially. Then, the segmentation model is employed to divide pre-processed data into the preferred units of analysis in an automated way. The ACODEA framework has been applied with the help of the SIDE tool. In the segmentation layer, the following features have been considered to be extracted from the text of online discussion: syntactic attributes, semantic attributes, and the unit of analysis. In the coding layer, the study has focused on categories which are based on the micro-argumentation aspect of the multidimensional framework offered by Weinberger and Fischer (2006). The message can be categorized as claim, ground, warrant, inadequate claim, evaluation, prompts or empty message.

The study of Law et al. (2007) has proposed a conceptual design for a learnable content and participation tool to be used in the CSCL field. The toolkit mainly consists of Preparatory, Analysis and Learning Mechanisms Components. Preparatory components have two major aims. First is transforming discourse data to an appropriate format, hence can be processed by analysis tools. Second is presenting a mechanism for definition of the coding schemes and coding rules. Analysis components are divided into three components. The participation and interaction analysis component reveals statistics at the individual and the interpersonal interaction levels. Individual related statistics are number of posts, replies or keywords of a learner. Interpersonal interaction is investigated according to social network analysis, hence involves corresponding measures such as betweenness, centrality, clustering cohesion and so

on. The text analysis component has three modules. One module is used to conduct keyword analysis to produce statistics regarding the percentage of keywords and key phrases used by the participants. The other module attempts to conduct a domain ontology analysis. The final module is used to acquire text segments including a keyword as well as specified length of text before and after the keyword. The coding support component allows users to perform content analysis with the help of text mining of discourse. Learning mechanism component consists of two modules. The coding rules refinement module utilizes hits, mistakes and misses lists of discourse segments and the coding effectiveness statistics to enhance coding rules. The coding scheme and rules modification module interprets keywords, keywords concordance results, and results from the domain ontology analysis.

A framework for designing the content analysis toolkit mainly consists of Preparation, Analysis, and Visualization & Export components (Li et al., 2007). The Preparation component enables loading of the data in HTML, XML or text formats, as typically logged by various CSCL environments. Each kind of data is changed into a standard format automatically. Then the coding editor allows the construction and storing of different types of coding structures. With the help of the transcript segmentation component, text can be divided into proper "meaning units" such as messages, paragraphs, sentences for the analysis process. The Analysis component performs various types of assessments. Learners' level of participation is analyzed to produce each learner's number of posts, replies, or number of keywords used in the discourse. Learners' interaction is evaluated through social network metrics such as betweenness, centrality, clustering cohesion, etc. The keyword extraction is performed to reveal a set of keywords and phrases, their frequency of use, and additional related information like speaker/contributor and time of posting. The concordance module analyzes the words or phrases used near the keywords to help analysts understand the meaning of a piece of text. The domain ontology-based text analysis is conducted based on the ontology of a specific domain. Semi-automatic coding support automatically suggests corresponding code/s based on keywords or patterns of the segment. The Visualization & Export component aims to demonstrate analysis results in various formats (e.g. graphs, curves, tables). In addition, this component transforms the analysis results into .csv files for quantitative and code co-location investigations.

2.4. Topic Detection in CSCL

Thanks to the developments in internet and communication technologies, several communication means have been developed. Chat medium is one of the most frequently used communication tools that allow textual communication among participants. It can be employed for different purposes such as for business, online courses, collaborative learning, gaming, and technical support. Online meetings of users typically take place in chat rooms which are virtual places for users' textual communication on the Internet. Chat can be supported through several tools for instant messaging (e.g., MSN Messenger, AIM), Internet Relay Chat(IRC), virtual game lounges (e.g., Battle.net, Steam), game environments (e.g., MUDs, MMORPGs), and collaborative learning environments (Uthus & Aha, 2013).

Most of the user interfaces of chat rooms are designed with similar components. Generally, one component is allocated for listing previous chat messages, one is allocated for listing online participants, and the other is allocated for typing a new message. Additional components can be integrated to the chat environments in parallel to goals of the communication. For instance, the Figure 3 demonstrates an online collaborative learning

platform (i.e. the Virtual Math Teams (VMT) chat) which additionally offers a whiteboard area for the purpose of learners' sharing and drawing ideas.

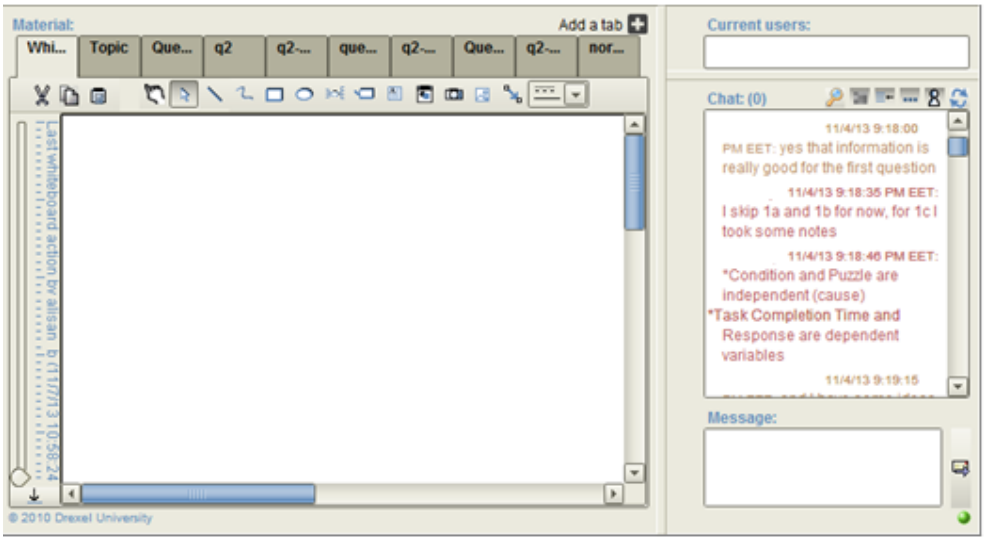

Figure 3. VMT Environment

A user message generally consists of three parts: the nickname identifying the author of the message, the timestamp showing the submission time of the message, and utterance with one or more sentences. In addition to user messages, activity and system messages can be generated by the system. For instance, activity messages in an online collaborative learning environment indicate the activity of the user in the whiteboard area. Similarly, system messages are generated for informative purposes such as announcing entrance or leave of a user.

The language used in chat environment is rather different from conventional text due to the real time and informal conversational structure of the chat messages. Chat language (or chat lingo) may include acronyms (e.g. use of "cu" instead of "see you"),short forms (e.g. use of "btw" instead of "between"), polysemes (e.g. use of "comp" instead of "company" or "computer" depending on the context, synonyms (e.g. use of "network adaptor", "network interface card", and "NIC" interchangeably to indicate computer networking issues) and mis-spelling of terms (e.g. use of "sooooo", "noooo" and "thee" instead of "so", "no" and "the" respectively) (Dong, Cheung Hui, & He, 2006). In addition, chat users frequently employ emotional expressions (e.g. :), :o) or icons in their chat utterances.

Because of the nature of chat conversations, the topic of the conversation may quickly change and lead to the occurrence of multiple topics in a session. Each chat topic is pointed by a thread, which is defined as "a sequence of messages among users conversing with one another, with messages being relevant to one another within the conversation" (Uthus, 2010). All messages of a thread typically focus on a specific topic.

Shen, Yang, Sun, and Chen (2006) offered to consider chat messages in three categories as start, reply, and end messages. Each message type is assigned a different role in a thread. Start messages signal the beginning of a thread, reply messages satisfy the continuation of a thread and provide response to prior messages, and end messages lead to the termination of the thread. By using a similar categorization scheme, Ozyurt and Kose (2010) attempted to

identify threads of a chat conversation by employing starting, continuing, and stopping patterns. According to their study, conversations are generally initiated with calling, greeting, and asking names. For example, greeting expressions like "hello" and "how are you" are commonly observed as initial messages of a thread. The continuing patterns are used to understand the continuation of the same topic during a conversation. The keywords such as "this" and "that" as well as short expressions like "yes", "no", and "I agree" are detected as continuing patterns. Stopping patterns have the role of ending conversations. The study offered that short expressions like ''okay", ''all right", ''ok", and "got it" signal the end of a thread.

Topic detection approaches aim to explore the subject being discussed in each thread of a chat conversation. This can be viewed as identifying topics discussed during a specific time period, or investigating the whole chat log and detecting the topics that are discussed within it. Topic detection approaches are often based on supervised or unsupervised methods. In supervised approaches, chat topics are previously determined from training text documents, and then topics are assigned to documents in test category. In unsupervised approaches, there is no prior study to explore topics emerged in documents. Instead, text documents are clustered in terms of their content similarity.

Supervised approaches have widely applied Naïve Bayes, k-Nearest Neighbor, and Support Vector Machine (SVM) techniques while classifying threads based on pre-determined topics. Ozyurt and Kose (2010) employed all these three techniques while identifying topics of Turkish chat messages. In their study, they developed indicative feature sets for topics and categorized messages according to these sets. After the classification, they additionally compared the results produced by techniques and found the SVM as the one with best performance. Elnahrawy (2002)'s study aimed to classify chat logs and newsgroup messages according to the pre-determined topics. Naïve Bayes, k-Nearest Neighbor, and Support Vector Machines (SVM) techniques are employed during the classification process. According to the results, Naïve Bayes classifier is found to have the best performance compared to other two methods. More specifically, the Naïve Bayes classifier requires less training time than the SVM technique, and requires less classification time than the k-Nearest Neighbor approach. Anjewierden, Kolloffel and Hulshof (2007) performed classification of chat messages obtained from the online collaborative work of students. The study employed Naive Bayes classifiers in order to determine functional roles of messages in terms of regulatory, domain, social, and technical categories. In their study, Dong et al. (2006) detected topics of MSN messages by using Naive Bayes, Associative Classification, and Support Vector Machine techniques. As in the study of Ozyurt and Kose (2010), the categorization was conducted according to previously established indicative word sets that belong to topics. The results of the study demonstrated that the SVM outperforms other two methods and produce better precision and accuracy values.

Unsupervised approaches employed several techniques while clustering chat messages. Shen et al. (2006) conducted a study for the detection of threads in a message stream. They applied three variations of the single-pass clustering algorithm and proposed one new technique that integrates the linguistic features. Single-pass clustering algorithms focus on similarity of messages in terms of existing words as well as time distance among messages. As linguistic features, sentence types and personal pronouns are considered. The results of clustering revealed that the proposed algorithm based on linguistic features outperformed the basic single-pass algorithm and its three variations. In their study, Wang and Oard (2009) proposed to employ social and temporal contexts with the use of corresponding formulas.

Social contexts are investigated in two different types: author and conversation context. According to the author context, messages from the same person most probably clustered into same conversation if they are temporally close to each other. The conversation context considers name mentions and the temporal context considers the time distance while grouping the messages.

Wang et al. (2008), and Adams and Martell (2008) applied connectivity matrices in order to construct parent-child relationships between messages. The messages are firstly transformed into TF-IDF term vector representations for the computation of message similarity. In Wang et al. (2008)'s approach links are created between two messages if their similarity exceeds a threshold value. This value is computed according to three different temporal features. Adams and Martell (2008) employed time-distance penalization, hypernym augmentation, and nickname augmentation in order to identify which message belongs to which thread. According to the results of the clustering, time-distance penalization is found to have the best impact on increasing the performance of their algorithm.

In a recent study, Mayfield, Adamson and Rosé (2012) followed a two-pass algorithm to identify three levels in a chat conversation: sentences, sequences and threads. In the first pass, sentences are labeled according to the features of unigrams, bigrams, and part-of-speech bigrams. Then, sequences are detected by employing a single-pass clustering algorithm. Each message is examined according to the threshold value which is computed by considering time distance and cosine similarity among messages. If the message doesn't pass the threshold, a new cluster is established. In the second pass, the sequences detected in the first pass are assigned to threads with the help of cluster classifiers.

Elsner and Charniak (2011) focus on coherence models which investigates text in its current context. The entity grid model divides a document into entities and their syntactic roles, such as subject, object, other, and not-present. The role of each entity can be predicted based on its previous roles and number of occurrences. Topical entity grid model considers topic to word distributions in addition to the previous features. IBM-1 model aims to generate the next sentence's content words by considering the words of previous sentence. Pronouns and discourse newness are the other two models. In addition, time gap, speaker identity, and name mentioning features were applied.

Trausan-Matu, Rebedea, Dragan and Alexandru (2007) developed a tool for computer supported collaborative learning that can discover new topics when they are introduced during a conversation. Their approach consists of finding frequent words in the chat after irrelevant words are removed. Topics are found by leveraging synonyms to find common words, searching for patterns among the topics that are dynamically introduced, and based on user feedback.

2.5. Knowledge Building

The Knowledge Building (KB) theory argues that knowledge is produced through the formation of common goals and negotiation of different perspectives (Scardamalia & Bereiter, 2003). The theory makes a distinction between learning and knowledge building. Learning is seen as an internal process that leads to a change in beliefs, attitudes, or skills. On the other hand, knowledge building is considered to result in the creation or modification

of public knowledge. Knowledge building proposes that learning proceeds through the process of building new cognitive artifacts as a consequence of common aims, group conversations, and synthesis of opinions. The process should enhance the existing understanding of persons within a team and should aim to develop the understanding of what is known about the issue or task at hand.

Twelve "Knowledge Building principles" have been suggested for addressing different goals such as educational guidelines, technology design definitions, and fundamentals for assessing current practices (Scardamalia, 2002, p. 9-12):

- **Real Ideas, Authentic Problems:** Knowledge problems are resulted from the purpose of understanding the real world. Ideas are proposed like real structures.
- **Improvable Ideas:** Ideas of individuals are considered as improvable objects.
- **Idea Diversity:** Idea diversity is necessary for the development of knowledge. Ideas are developed by the help of comparisons, combinations and arrangements with other ideas.
- **Rise above:** The continuous enhancement of ideas and understanding provide students with developing upper level concepts.
- **Epistemic agency**: Individuals adopt a personal and mutual responsibility in order to accomplish knowledge building purposes.
- **Community Knowledge:** Knowledge Building aims to improve collective knowledge of individuals.
- **Democratizing Knowledge:** All participants of the learning groups are expected to contribute to the knowledge advancement.
- **Symmetric Knowledge Advancement:** Knowledge is not only transferred from more knowledgeable to less knowledgeable ones. The expected structure is the one that all groups gain knowledge through their joint efforts.
- **Pervasive Knowledge Building:** Students' contributions are essential factors for collective knowledge building.
- **Constructive Uses of Authoritative Sources:** Knowing a discipline means knowing authoritative sources that contribute to the existing knowledge.
- **Knowledge Building Discourse:** Through the discursive activities of the community, the knowledge is improved and transformed.
- **Concurrent, Embedded, and Transformative Assessment:** Assessment is used to detect problems as the work progresses and integrated to the works of the community. Internal assessments are conducted by the community to ensure that community work address to requirements of external assessors.

According to the theory of knowledge building, one important sense of the group should be functioning collectively instead of just gathering of individuals. This kind of environments can be achieved through different Web 2.0 tools such as blogs, wikis, virtual worlds and CSCL environments, as well as with discussion tools embedded in learning management systems.

Computer-supported Intentional Learning Environments (CSILE) project is considered as the initial attempt to equip schools with technology for the purpose of accomplishing knowledge building communities (Scardamalia & Bereiter, 1994). CSILE with its latest variation named as the Knowledge Forum was proposed as an educational software for supporting collaborative knowledge building activities through the demonstration of ideas in textual, audio, graphical, and video formats, and the organization of learning outputs. The project

mainly focuses on production of knowledge through the collaborative study of students facilitated by teachers. Therefore, the distributed cognition model was utilized, and social formations and discourse characteristics were investigated in this social learning environment. The study classified characteristics of knowledge building communities into three categories (Scardamalia & Bereiter, 1994). Firstly, the focus is on problems instead of knowledge categories or topics. The depth of understanding is achieved with the help of argumentation and active participation. Secondly, the community is characterized as a decentralized and open learning environment that fosters collective knowledge building. More knowledgeable learners are encouraged to take active roles in the learning process instead of standing outside the community. Participation of less knowledgeable learners is also essential to identify what is difficult to understand and whether explanations are sufficient for understanding. Thirdly, technology allows learners to access various databases, videos and other data resources as well as live experts and more advanced learners.

Similar to CSILE, another large-scale implementation of the knowledge building theory was realized via the Learning through Collaborative Visualization (CoVis) Project aimed to transform traditional science learning with the use of networking technologies which allow students to work collaboratively with distant students, instructors and scientists (Edelson & O'Neill, 1996). The envisioned and implemented learning context aimed to support and facilitate inquiry oriented collaborative activities with the help of several collaboration and communication tools, which include desktop video teleconferencing, shared software environments for remote/realtime collaboration, access to the World Wide Web resources, a multimedia scientist's notebook and scientific visualization software. This line of work is still being pursued for supporting science education at urban schools in Illinois, USA.

Various methods have been used for the assessment of group or community knowledge as they are captured in knowledge artifacts in environments such as CSILE and CoVis. Generally, assessment can be done in terms of group products, which can be a report, a plan, a software application, a design artifact, etc. However, not all group work may constitute a well-defined, coherent product, and not all products may represent contributions and understandings of all group members. Therefore, in general it is difficult to trace the development of knowledge at the individual and group levels by investigating the final stage of the knowledge artifacts in such environments. In most online learning environments, online discussions are treated as the major learning activity and online activity logs are considered as the groups' main knowledge building products. Studies focusing on the temporal organization of such logs aim to trace the knowledge building trajectories of each group and individual. However, such an undertaking brings its own challenges, due to emergent structures and discontinuities in interaction. As an alternative approach, some researchers utilize peer assessment methods for the analysis of group learning, which seeks for evidence of learning based on students' reflections on each other's activities, eliminating the need for performing detailed log analysis (Strijbos & Sluijsmans, 2010). Despite such advantages, as the investigation of group products brings further burden on the the students, their assessments of their peers and the group's work may be too narrow in coverage for a detailed analysis of knowledge building processes (Hong & Scardamalia, 2014).

Additionally, a set of alternative methods have been suggested for the analysis of knowledge building. For instance, learners may be required to submit portfolios to provide reflections on their learning during the course of their collaborative study. As another assessment method, students may be asked to perform some specific tasks named as "guided inquiries" based on what they explored together, where the goals, key questions and procedures are provided by

the teachers or facilitators (van Aalst, 2012). Both portfolios and guided inquiry activities provide researchers further evidence about learning through knowledge building at the individual level. However, such approaches are limited in their treatment of group level phenomena and accounting for what led to the learning outcomes evidenced in portfolios or guided inquiry exercises.

Statistics that capture different aspects of knowledge building activities are also employed for assessment purposes. The majority of online environments employ assessment measures such as average number of notes created, notes read, notes revised, words per note etc (Hong & Scardamalia, 2014). These measures can be effective in identifying behavioral patterns of learners and interaction patterns of groups. However, they are not appropriate for the analysis of contents of the knowledge elements the groups are working on. In order to overcome this problem, content analysis methods are often employed to investigate the knowledge content generated by the learners.

One of the main purposes of knowledge building theory is to propose practical principles that could direct pedagogy in various social contexts for learning. Instead of specific activity structures, procedures, or rules, a set of knowledge building principles are proposed for the assessment of activities in collaborative learning environments (Scardamalia & Bereiter, 2003). Based on these principles, Chan et al. (2001, p. 7-8) provided four principles for characterizing the process of knowledge building, which are summarized as follows:

- **Working at the cutting edge:** The main idea of this principle is that the community works for enhancing their collective knowledge. The principle emphasizes productive questions and responses during the knowledge-building process. Productive questions are important elements for guiding the community's interests towards a productive investigation of shared problems. Productive responses can help the members identify misconceptions or inadequate understanding of a key issue, which may stimulate further inquiry and progress.
- **Progressive problem solving:** According to this principle, the knowledge building process requires constant attempts for resolving conflicts and providing answers to questions, thus resulting in a deep understanding of important common issues. This principle focuses on classroom discussions that have evidence for the emergence of high level of understanding of key concepts or the evolution of an effective solution approach or strategy.
- **Collaborative effort:** This principle considers the significance of working on a collective goal and values for increasing the knowledge of the community. The main idea is that learners demonstrate attempts to assist others in understanding the common problems. Knowledge should be exchanged through negotiations of perspectives in interaction, which is the primary means through which new knowledge is created in a knowledge community.
- **Identifying high points:** According to this principle, metacognitive understanding is essential for the knowledge building process. It focuses on personal knowledge development and the insights students gain on their own learning process. As the evidence of high points, one can consider a particular learning experience or a sudden moment of insight, where students' behaviors or comments suggest that they begin to recognize issues in new ways with the help of their peers.

In this study, we employed the Progressive Knowledge Building Inquiry cycle in order to analyze learners' conceptual development in a CSCL environment called VMT. Further details about this KB cycle are provided in the Methodology section.

Summary

Our review of the related literature demonstrated that existing studies approach the analysis of computer-supported collaborative learning processes in several different ways. SNA based approaches generally investigate the structure of the social network based on the interactions of learners in terms of some special metrics such as centrality, density, roles, groupings/cliques etc. Discourse analysis is concerned with communicative and coordinative functions of chat messages. Content analysis focuses on devising categorization schemes to analyze linguistic content of messages as well as the contents of graphical and other narrative resources. Topic detection approaches aim to explore the subject being discussed in each thread of a text-based chat conversation. Although all of these methods provide important insights into collaborative learning processes, the methods in isolation can only partially capture the structure and the organization of collaborative interactions mediated by CSCL systems. These methods attain further significance when they are considered in a complementary way with the aim of improving our theoretical understanding of technology mediated collaborative learning.

Knowledge building theory is a candidate theoretical framework where these methods can be brought together to better understand the structure and the organization of collaborative learning activities. The KB theory has influenced the design of innovative systems such as CSILE and the Knowledge Forum that promote radically different pedagogies as compared to conventional education. The KB theory also provides a conceptual framework that helps researchers and practitioners characterize the social nature of learning. However, knowledge building principles have been mainly utilized for making a general assessment of activities that took place in collaborative learning environments (Scardamalia & Bereiter, 2003). Finding more effective ways to operationalize KB concepts and relate them with the methods mentioned above is still an active area of research in CSCL (Lund, 2011).

Motivated by this need for more effective ways to combine various analytic methods for the abovementioned theoretical and practical concerns, in this study we aimed to analyze learners' knowledge building processes according to the Progressive Knowledge Building Inquiry cycle framework, which involves major principles of the knowledge building theory. According to the current literature, there is a need for investigating the strategic use of existing learning analytic methods in the service of analyzing and evaluating both collaborative learning processes and the learning outcomes. Ideally, assessment should provide support to enhance both the process and deliverables of the collaboration (Collazos, et al., 2007). In this respect, our study explores the use of a particular combination of multiple methods that aim to investigate learners' chat discussions (process) as well as the delivery of learning outputs (products). For this purpose, our methodology combines topic detection, content analysis and knowledge building approaches. By the use of topic detection method, we aim to identify the content of the chat discussions and categorize the focus of threads. Through the knowledge building approach, we deeply investigate learners' collaborative process and identify their indicators for knowledge building. The content analysis allows us to analyze the wiki output, which is the final delivery of learning groups.

With these approaches, we investigate learners' collaboration in a semester long course, which is generally not considered by existing studies.

Despite their potential for facilitating deep conceptual development, knowledge building activities are notoriously difficult to analyze through conventional methods due to the unpredictable, partly chaotic, and emergenistic nature of those activities. As our review of the literature suggests, there is no single methodology that can capture the full complexity and richness of knowledge building discourse. In this thesis, we aimed to develop a set of tools that aim to help researchers and practitioners to flexibly investigate collaborative knowledge building activities mediated by a CSCL environment through multiple dimensions, and apply those tools on empirical data to demonstrate their use on tracing the development of statistics concepts in a series of semester long knowledge building activities. Our approach can be distinguished from existing work in terms of its focus on balancing structure and flexibility, where the structure comes from the pedagogical design of the tasks/activities that aim to guide students' inquiry, whereas the flexibility comes from the way the logs are processed into segments and the way their semantic contents are related to the structure provided by the facilitator of the course. Knowledge building theory emphasizes conceptual development through students' invention of their own ways of thinking and expressing the relevant concepts, so the methods we developed for processing this data can only partially cover some of the creative insights and conceptual developments experienced by the students. Through a qualitative analysis of excerpts identified as relevant to important knowledge building activities of students, we aim to demonstrate a possible use of these tools for making sense of and analyzing learning activities supported by a CSCL system.

CHAPTER-3

METHODOLOGY

3.1. Research Questions

VMT was developed as a CSCL environment which provides a chat function for collaboration of learners at the small group level and corresponding wiki pages for their knowledge sharing at the community (e.g. classroom) level. Our focus in the chat setting is on learners' task related discussions which reflect learning groups' collaborative studies about the assignments. In addition, we consider analyzing wiki content and reflections of learners' chat discussions to the wiki output. We attempt to address the following research questions in this study:

1) Which segments of chat logs reflect learners' collaborative studies on assignments?

2) Which target concepts are discussed within the task-relevant segments of chat logs?

3) How learners accomplish conceptual development during their collaborative study in chat environments?

4) How are the contents of chat discussions and wiki postings relate to each other?

5) How are the process measures devised by learning analytics methods and the measures for overall learning outcomes relate to each other?

3.2. Overall Design of the Study

Design of the study was summarized in the Figure 4.

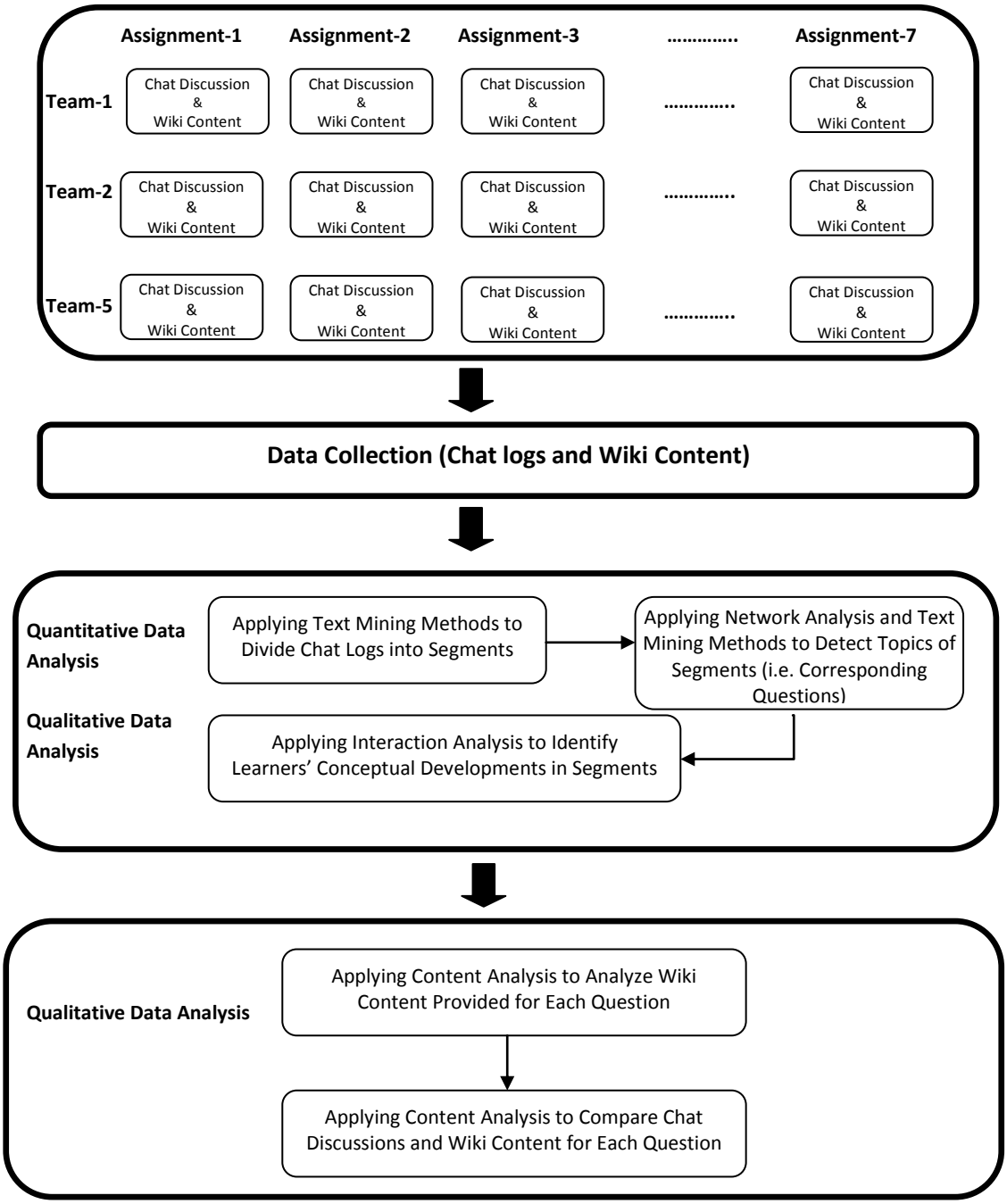

Figure 4. A Summary of the Main Steps of the Data Analysis

We conducted the study in the context of a graduate level Research Methods & Statistics course during 2013-2014 fall term in a large state university in Turkey. The course aimed to introduce basic concepts of empirical research and experimental design. The course was structured in a way that the instruction was provided face-to-face and assignments were collaboratively completed online. There were 15 registered students in the course. Each registered student was assigned to a learning group and five teams were constructed in total. All teams were required to complete the course assignments by collaboratively working online in the VMT environment. The seven weeks of the semester were allocated for the implementation of weekly assignments. The aim of the online activities was to help students develop their understanding of key statistics concepts through collaborative assignments where they attempted to carry out a specific type of analysis by using the SPSS software. In each assignment, learning groups were initially required to perform online chat meetings, then publish their findings as co-authored wiki documents.

During the term, learning groups worked on totally seven homework assignments of the course and submitted the results of each assignment as a co-authored report in the online wiki environment. Learning groups participated in a series of online meetings in order to supply responses for questions of each assignment. Students were expected to communicate with their group members by using only the VMT system, hence their whole communication could be monitored. With the help of different functions of the VMT, students could collaboratively work for completing the assignments. The chat function of the VMT allowed students to collaborate in a synchronous manner. While posting chat messages, students could use the whiteboard tool to clarify their solutions with the help of various drawing constructions or posting screenshots of their SPSS outputs. By completing discussions and using appropriate functions of the VMT, students were expected to summarize the findings of their collaborative work as Wiki outputs. Each learning group was required to submit Wiki contents involving textual information and graphical demonstrations for seven different assignments of the course.

After the term ended, we collected data related to learning process of each team. These data consists of chat logs automatically generated by the VMT system and the wiki content provided by the teams on the basis of each assignment. The chat log mainly consists of textual message content as well as the teams' whiteboard activities together with author and time information. The wiki content is published online, organized in terms of questions of the assignment, and includes both textual and graphical components to provide explanations for solutions.

In this study, we attempted to understand the results of applying semi-automated methods for tracing and evaluating knowledge building processes which were observed in multiple media (chat and wiki) and multiple time periods (synchronous and asynchronous).Our purpose is to investigate the learning groups' knowledge building processes by employing learning analytics and qualitative interaction analysis methods in order to identify whether learners demonstrate conceptual development or not. In this regard, we employed both quantitative and qualitative methods to the same chat and wiki data, therefore we considered the use of mixed methods research design.

Each course is organized around its specific learning outcomes, content and plan. This organization determines the concepts that learners should comprehend and think about. The knowledge building theory doesn't consider learning as a simple knowledge acquisition process, instead it characterizes learning as an active process of social inquiry from a social

constructivist perspective. Hence, while collaborating to understand the concepts of the course, learners may have difficulty in understanding some concepts, and may develop special terms and behaviors while discussing about some problematic issues. Such practices or shared concepts developed by the students while discussing the given problems is of theoretical importance for knowledge building theory and CSCL, so it is important to trace these developments in relation to learning goals of the collaborative activity. However, there may not be a one to one match among these elements and the contents provided by the course materials. By considering this possibility, we utilize the methods of learning analytics in order to investigate the data produced during the course, which was constructed to seed and support the knowledge building processes. Therefore, qualitative interaction analysis produces the gold standard results in our study. We observed learners' interaction related to some predetermined concepts of the course and identified the outcomes they achieve with the help of the research that we conducted in the qualitative case studies in a broad time period. By investigating the qualitative findings in relation to the results we obtain through text mining and social network analysis methods, we aim to explore ways to provide analytics that go beyond the surface level, in an effort to aid the instructors who have limited time for making a deep assessment of collaborative activities according to the knowledge building principles. In our approach, the qualitative analysis is especially important to make interpretations about the knowledge building processes supported by chat and wiki activities.

In this study, we employed both quantitative and qualitative methods to analyze chat logs and wiki outputs. For the analysis of chat logs, our approach consists of segmentation analysis to divide chat logs into segments, topic detection for identifying general focus of these segments, and interaction analysis of episodes for tracking learners' development of concepts evidenced in task-related segments.

The purpose of segmentation analysis is to capture how participants organize their chat interaction into long sequences (i.e. segments). In this analysis, we investigated chat logs to identify activity boundaries where new activities are initiated and current activities are terminated or suspended. The results of the segmentation analysis are chat segments, each of which is dedicated to a different topic.

Topics of chat segments are generally related to questions of the assignments. In order to reveal the topic of each segment, we focus on frequent keywords that teams utilized while they were collaboratively working on solving the questions. By employing a two mode network analysis approach, we identified indicative words for each question of each assignment. As the next step, we consider the relation between segments and indicative words of the questions in order to understand which segment maps to which question (i.e. topic). For this comparison, we employed the latent semantic analysis (LSA) method to find the mapping among segments and questions.

With the help of interaction analysis, we attempt to examine how learning groups developed their understanding of key concepts in statistics during their collaborative activities distributed across multiple interaction spaces and spanning the entire semester.

Wiki output is organized in parallel to questions of an assignment, since the wiki document is treated as the group's answers to the homework questions. Therefore, each wiki segment directly maps to a question of an assignment. For the analysis of wiki content, we employed the content analysis approach and aimed to identify whether the provided content was a sufficient solution for the corresponding question. In addition, we compared the wiki content

with the solutions proposed in the chat environment, hence explored the additions or removals in the finalized solution provided in the wiki environment.

3.3. Setting and Participants

3.3.1. The CSCL-environment - Virtual Math Teams (VMT)

In this study, we used the Virtual Math Teams (VMT) system to support and record the collaborative learning activities that took place in the context of a semester long course on research methods and statistics. The reason of our choice is that the VMT provides a variety of tools (i.e. chat, whiteboard and wiki tools) which enable learning groups to collaboratively study on statistical concepts in the context of a course.

The VMT system was developed in the US as part of a research project that aims to support collaborative math problem solving activities at a distance. The project consists of an interdisciplinary group of researchers, including math educators among the Math Forum personnel, and an international group of researchers in the learning sciences. Although the VMT system primarily attempts to serve the mathematics education domain, learning groups can use this platform to engage in collaborative learning activities in other domains as well (Stahl, 2009).

Instructors and students can register to VMT system freely. Instructional activities in the VMT system typically progress in a structured way. Initially, instructors publish homework and assign students to learning groups. In the chat environment, each team begins to discuss, share their ideas and understandings to solve problems. Groups may not complete their work and come to a solution in one discussion session. Teams can meet online in different sessions to finalize their solutions. The persistent availability of the chat room contents allow teams to pick their discussion from where they left before. The next duty of learning groups typically involves the co-authoring of a shared document capturing the ideas and the solutions they came up with as a team. In the VMT, student groups are provided a Wiki space to publish their group findings by organizing the essential text and drawings they produced during their chat discussions.

The VMT online environment consists of three major components: the lobby, the chat room, and the wiki. The sample screen of the lobby is demonstrated in the Figure 5.

The lobby supports the use of several functions with the help of its various sub pages. The key function of the lobby is that it lists existing chat rooms, which can be also reached through the “List of All Rooms” link. The list covers whole chat rooms created by registered users of the VMT. There is no restriction for entrance to any of these chat rooms. After selecting the room they are interested in, learners can gain access, and hence communicate with the individuals logged into that room. Similarly, the “My Rooms” page provides a list of chat rooms that the user accessed previously. The registration to chat rooms can be accomplished by the instructor or the learner himself. Registered users gain rights to manage their profiles. More specifically, from the “My Profile” page, learners can review and edit their profiles or change their passwords. Each individual can be assigned to a specific team involving a group of learners. Learning teams are established by instructors or members. With the help of the “My Teammates” page, individuals are allowed to review the profiles of their teammates. At the same time, by employing the “Messages” page, learners can send

messages to each other for coordinating chat sessions, proposing an idea, providing a useful resource or for other purposes etc.

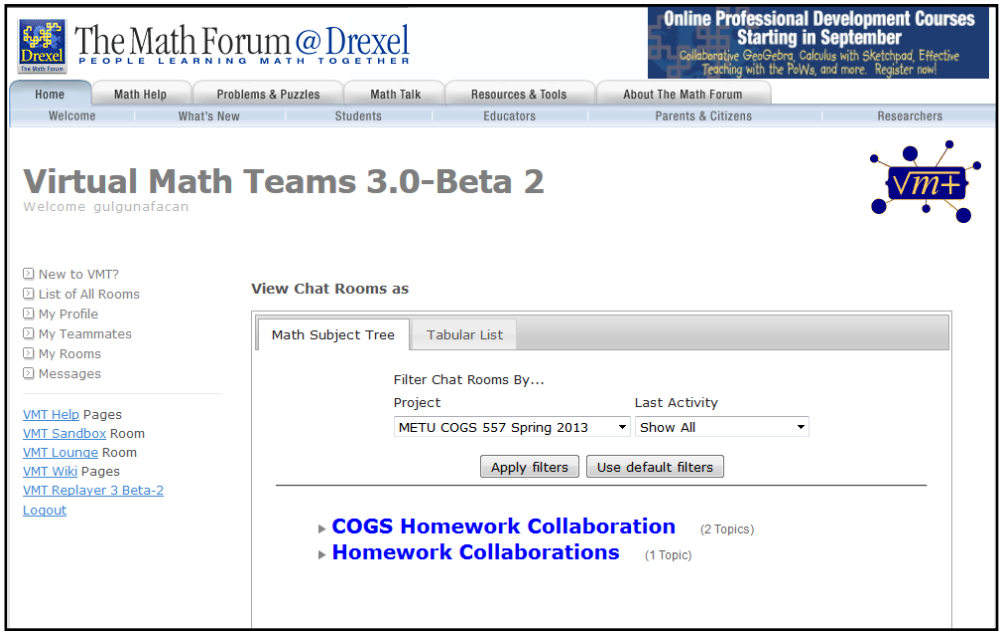

Figure 5. VMT Lobby

The lobby provides additional functions for the instructors. First of all, instructors can generate accounts for their students, especially for the ones registered to their courses. In the context of each course, instructors can produce related online activities and organize those activities under a single project to facilitate navigation in the VMT system. Instructors can examine conditions of chat rooms such as their status of being active or passive. Therefore, instructors can be involved in active chat rooms and guide learners in these rooms if necessary. Additionally, the teacher interface allows instructors to export chat room contents into spreadsheet documents. In this way, instructors can analyze the quantity and the quality of learner contributions to the group work. Finally, the lobby directs users to the VMT help manual and other informative resources about the VMT.

The chat component of VMT mainly supports synchronous communication of members in a learning team. The VMT provides a list of online team members in the chat environment. Each member can send messages, and read posts of members in the team. Navigation through chat postings is provided in order to examine the content of the chat and review the history of the chat when needed. At the same time, chat rooms consist of several shared whiteboards for drawing and organizing ideas. For instance, the screenshot of VMT chat in the Figure 6 demonstrates a group's work in the whiteboard area. Learners employ the corresponding tool in order to share their statistical findings for the related question of an assignment. Web browser facility is also provided in the chat room, thus learners can collaboratively browse the web when it becomes essential to conduct research related to the topic of their group work. Moreover, each chat room has a corresponding wiki page, from which students can share their findings over the Internet.

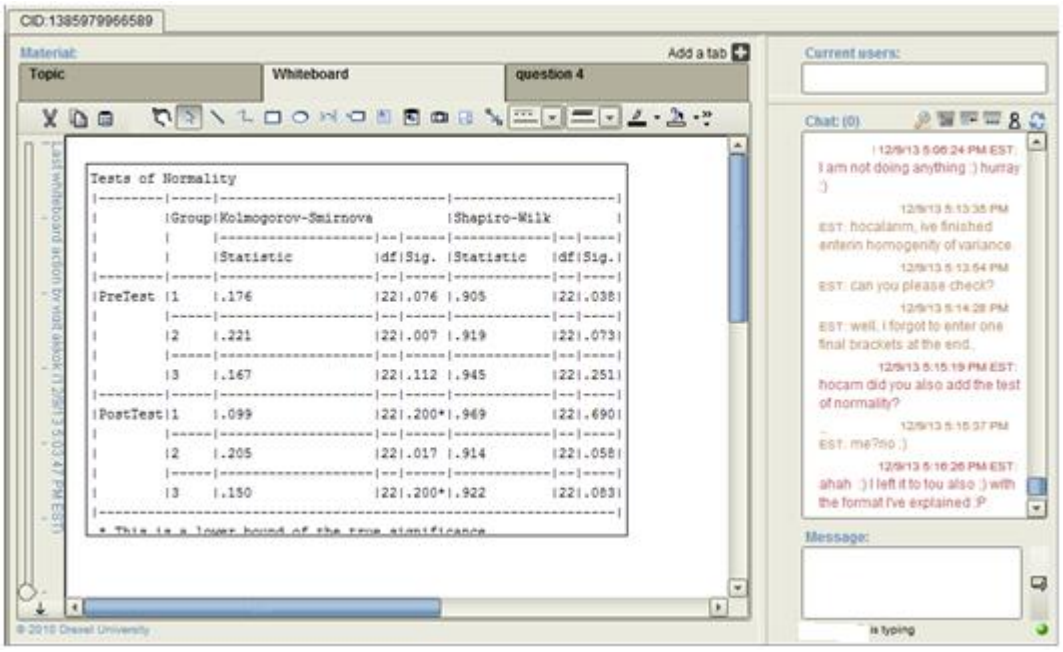

Figure 6. VMT Chat

The contents of the VMT Wiki are made publicly available on the Web. However, students should register to VMT in order to edit and share information through a wiki page. For instance, the screenshot of VMT wiki in the Figure 7 depicts a portion of the text submitted by one of the learning groups for the solution of an assignment. Other learning groups are allowed to review but prevented to make any changes on this kind of content. That is, the Wiki content can be only edited by the owner group. With the help of 'View history' link, learners can view the list and details of Wiki edits conducted by each learner. Initially, time, author and order of editions about Wiki content are provided. After clicking on the edition, one can learn about its details which are related to insertion, change and delete activities in the wiki content. The Undo function enables learners to revert the current contents of the Wiki page to a specific version in the past. Moreover, there is an option to compare two different revisions conducted by learners. In this way, differences in two revisions can be investigated.

Figure 7. VMT Wiki

3.3.2. The Research Methods Course and Participants

We performed the study in the context of a graduate level Research Methods & Statistics course. The course aimed to introduce basic concepts of empirical research and experimental design. The students were introduced to methods and methodology of psychological research (experiment, observation, independent/dependent variable(s), ex-post-facto design, cross-sectional studies, longitudinal studies), Descriptive Statistics (building statistical models, the relation between population-sample, distributions, various central tendency values, variance, standard deviation, standard error, confidence intervals, test statistics), as well as to univariate and multivariate forms of Inferential Statistics (General Linear Model (GLM), ANOVA, ANCOVA, MANOVA, repeated measures ANOVA, mixed design ANOVA, correlation, regression, non-parametric tests, factor analysis). Statistical analyses were conducted using Statistical Package for the Social Sciences (SPSS).

There were 15 registered students in the course. Each registered student was assigned to a learning group and five teams were constructed in total. Demographic characteristics of students were provided in the Table 2.

Table 2 Demographic Characteristics of Students

Team-1			
Subject Handle	A_S	G_C	Y_A
Gender	Male	Female	Male
Grade	PhD	Masters	Masters
Undergraduate major	Physics	Foreign Language Education	Electric and Electronics Engineering
Graduate major	Biomedical Engineering	Cognitive Science	Cognitive Science
Current GPA	3.00-3.50	3.00-3.50	3.00-3.50

Table 2 (cont.)

Team-2			
Subject Handle	H_A	Z_B	M_G
Gender	Male	Female	Male
Grade	PhD	PhD	PhD
Undergraduate major	Computer Science	Foreign Language Education	Mechanical Engineering
Graduate major	Cognitive Science	Cognitive Science	Medical Informatics
Current GPA	3.00-3.50	3.00-3.50	3.00-3.50
Team-3			
Subject Handle	F_I	N_M	E_U
Gender	Male	Female	Male
Grade	PhD	Masters	PhD
Undergraduate major	Electric and Electronics Engineering	Foreign Language Education	Philosophy
Graduate major	Medical Informatics	Cognitive Science	Cognitive Science
Current GPA	3.50-4.00	3.50-4.00	
Team-4			
Subject Handle	F_A	C_K	M_S
Gender	Male	Female	Male
Grade	Masters	Masters	PhD
Undergraduate major	Foreign Language Education	Computer Science	Business Administration
Graduate major	Cognitive Science	Cognitive Science	Information Systems
Current GPA	3.00-3.50	3.50-4.00	3.50-4.00
Team-5			
Subject Handle	A_B	D_C	H_K
Gender	Male	Female	Male
Grade	PhD	Masters	PhD
Undergraduate major	Electric and Electronics Engineering	Foreign Language Education	Computer Education and Instructional Technology
Graduate major	Cognitive Science	Cognitive Science	Cognitive Science
Current GPA	3.50-4.00	3.00-3.50	2.50-3.00

All teams were required to complete course assignments by collaboratively working online in the VMT environment. In the initial weeks of the semester, students were introduced to the VMT environment through an online orientation session organized by the course instructor. The remaining weeks were allocated for implementation of weekly assignments. In each assignment, learning groups were initially required to perform online chat meetings, then publish their findings as co-authored wiki documents.

During the term, learning groups have worked on totally seven homework assignments of the course and submitted the results of each assignment as a report co-authored in the online

wiki environment. Learning groups participated in a series of online meetings in order to collectively figure out responses to the questions of each assignment. Students were expected to communicate with their group members through only the VMT environment, hence whole communication could be monitored. With the help of different functions of the VMT system, students could collaboratively work for completing their group assignments. The chat function allowed students to collaborate in a synchronous manner. While posting chat messages, students could also use the whiteboard tool to clarify their solutions with the help of various drawing constructions. By completing discussions and using appropriate functions of VMT, students were expected to summarize the findings of their collaborative work as Wiki outputs. Each learning group was required to submit Wiki contents involving textual information and graphical demonstrations for seven different assignments of the course.

The online activities were graded as group projects which constituted half of the total grade students obtained from the course. The remaining half of the grade was based on individual test scores students obtained from two conventional exams.

The aim of the online activities was to help students develop their understanding of key statistics concepts through collaborative assignments where they attempted to carry out a specific type of analysis by using the SPSS software. Some concepts such as identification of independent/dependent variables, and their scale of measurement, checking parametric assumptions (i.e. normality and homogeneity of variance), the notion of null hypothesis and statistical significance, and applying the statistical test were common to all online activities due to their central role in statistical analysis. Developing a deep understanding of each of these concepts were targeted as learning goals of the course. Our study focuses on learners' progress in these key dimensions during the entire term on the basis of seven assignments, which were provided in the Appendix.

3.4. Data Collection

After the term ended, we collected data related to learning process of each team. These data consists of chat logs and wiki content which were generated on the basis of each assignment. For each assignment, one chat log file and one wiki content was generated for a learning group. Since there are five teams working on seven assignments, in total, 35 chat logs and 35 wiki documents were obtained in this study.

The actions of participants in the chat environment were recorded as chat log files, which were automatically logged by the VMT system. An excerpt from a sample log file together with its fields is depicted in the Table 3.

Table 3 VMT Chat Log File

Line	Date	Start Time	Post Time	Duration	EventType	G_C	Y_A
25	11/13/2013	54:42.0	55:14.6	0:00:32	chat	and gender is binary, wheras all IQ variables are ratio	
26	11/13/2013	54:57.8	55:07.0	0:00:09	chat		gender is nominal.
27	11/13/2013	55:08.2	55:46.1	0:00:37	chat		brain volume, body height and body weight should be raito variables as well.
28	11/13/2013	56:04.8	57:21.2	0:01:16	chat	yes. i will try to justify the reasons, and you'll correct me if i'm wrong.	
29	11/13/2013	03:40.5	05:57.2	0:02:16	chat	excuse me, would it be wrong if i say brain vol, height and weight are interval variables? I couldnt decide, i also thought they were ratio at first, but then, since they are measured at scales like cm and kg, maybe interval would also be the answer??	
30	11/13/2013	12:22.1	13:17.5	0:00:55	chat		a variable is a ratio variable if you can say this: "the subject with value 2x is tiwce as whatever as the subject with value x".
31	11/13/2013	13:19.1	13:42.6	0:00:23	chat		for example, we can say "the subject weighing 100 kg is twice as heavy as the subject weighing 50 kg"
32	11/13/2013	13:43.5	13:50.1	0:00:06	chat		so weight is a ratio variable.

The chat log records the author, date, start time, post time, duration, and event type for each action entry. Remaining columns are allocated for indicating chat messages and other activities of students (e.g. awareness messages such as user is typing, drawing on the whiteboard etc.). The line value indicates the order of the chat posting and date shows the date that the chat posting is submitted. There are three different timing values. Start time indicates the time that user begins to write the chat posting whereas the time indicates when that chat posting is submitted. The duration demonstrates the difference between start and post times of a chat posting. The post time also indicates when the message is posted into the group's chat stream, and hence become visible to other members. Event type categorizes the learner activities as chat or whiteboard activity, or messages produced by the system. The chat environment also allows users to explicitly link their messages to previous messages or to an area on the shared whiteboard. Such links are called references. There can be two types of references. One type shows relations between two postings if user makes any reference to a previous chat posting by double clicking on that posting. The other demonstrates the relation between chat statement and object if user makes any reference to an object in the whiteboard environment. The referencing feature aims to reduce the likelihood of chat confusion that occurs due to non-sequential ordering of related chat messages as a consequence of their production in parallel.

The wiki content is published online and includes both textual and graphical components to provide explanations for solutions. For instance, the screenshot of VMT wiki in the Figure 8 depicts a portion of a text submitted by one of the learning groups as part of their solution for an assignment.

Figure 8. Wiki Submission Sample

The Wiki content is organized according to questions of the assignment. Each question consists of textual explanation of the question and the team's solution with textual and graphical content. If the team has no solution for a particular question, then they tended to provide no content corresponding to that question.

3.5. Data Analysis

Our study analyzed 71% of the whole data. More specifically, of the chat data collected in this study, we identified the ones produced by teams 1, 2, and 5, which contains 6978 chat messages in total. The remaining data (i.e. produced by teams 3 and 4) containing 2735 chat messages were not analyzed in our study, primarily due to their infrequent use of the chat tool to discuss the homeworks. One of these groups did not even use the wiki to co-author their joint reports and submitted their assignments via email for the first few homeworks.

The participation frequency changes according to the group's decisions for the arrangement of online meetings to work on assignments. The instructor planned each assignment to be completed in one week. In this duration, groups met for two to four times according to their progress in completing the assignment. Groups' participation levels in chat and wiki are demonstrated in the Table 4.

Table 4 Learning Groups' Participation Levels

Team-1	**Number of Chat Message**				**Number of Wiki Activity**			
Assignment	**A_S**	**G_C**	**Y_A**	**Total**	**A_S**	**G_C**	**Y_A**	**Total**
1	42	45	11	98	20	6	8	34
2	197	85	59	341	59	14	6	79
3	66	54	0	120	7	6	0	13
4	146	122	54	322	4	10	2	16
5	61	52	0	113	11	3	0	14
6	190	139	26	355	3	21	0	24
7	113	90	0	203	5	9	0	14

Table 4 (cont.)

Team-2	Number of Chat Message				Number of Wiki Activity			
Assignment	**M_G**	**Z_B**	**H_A**	**Total**	**M_G**	**Z_B**	**H_A**	**Total**
1	9	43	93	145	1	23	21	45
2	23	103	105	231	4	31	0	35
3	138	206	415	759	2	0	0	2
4	32	70	94	196	3	0	18	21
5	0	39	57	96	0	0	16	16
6	0	0	0	0	0	0	19	19
7	81	268	241	590	14	11	15	40

Team-3	Number of Chat Message				Number of Wiki Activity			
Assignment	**N_M**	**F_I**	**E_U**	**Total**	**N_M**	**F_I**	**E_U**	**Total**
1	124	149	195	468	0	0	0	0
2	0	0	0	0	0	0	0	0
3	127	120	14	261	0	0	0	0
4	21	10	6	37	0	6	2	8
5	35	59	0	94	13	4	0	17
6	31	57	0	88	34	10	0	44
7	14	15	0	29	6	11	0	17

Team-4	Number of Chat Message				Number of Wiki Activity			
Assignment	**C_K**	**M_S**	**F_A**	**Total**	**C_K**	**M_S**	**F_A**	**Total**
1	94	157	223	474	0	0	0	0
2	0	29	61	90	0	0	0	0
3	0	48	19	67	0	0	0	0
4	20	52	33	105	14	0	0	14
5	0	33	2	35	0	0	0	0
6	0	70	11	81	0	0	0	0
7	0	14	0	14	0	0	0	0

Team-5	Number of Chat Message				Number of Wiki Activity			
Assignment	**H_K**	**A_B**	**D_C**	**Total**	**H_K**	**A_B**	**D_C**	**Total**
1	118	185	148	451	12	24	8	44
2	63	39	28	130	7	29	0	36
3	168	198	76	442	9	12	0	21
4	169	170	133	472	4	10	0	14
5	31	58	52	141	14	5	2	21
6	89	42	39	170	29	10	0	39
7	46	0	38	84	24	0	0	24

The corpus had two major challenges for the analysis: it contains non-English words and it has noisy structure due to misspellings and abbreviated use of words (i.e. chat-lingo). Hence, we performed data preprocessing before initiating the chat analysis. As the first step, we classified chat messages in terms of their language content. Although approximately 95 % of the discussions were held in English, learners may prefer to use Turkish for social chit-chat, typically including non-task related messages. This was an anticipated attitude since learners may prefer to use their native language for socializing. However, our focus is on conversations on task related issues. Therefore, we removed chat data in Turkish language and kept the ones in English language. In the end, the resulted corpus contains 95% of the chat log content produced by teams 1, 2, and 5. The noisiness in data was resulted from misspellings and abbreviations. Therefore, as the second step, we converted misspelled words and abbreviations in chat messages to their proper forms. After these procedures, the data became ready for the subsequent steps of our analysis.

Research Question-1 - Which segments of chat logs reflect learners' collaborative studies on assignments?

Segmentation analysis aims to capture how participants organize their chat interaction into long sequences (i.e. segments) consisting of a set of ordered chat messages. In this analysis, chat logs are investigated to identify activity boundaries where new activities are initiated and current activities are terminated or suspended. That is, transitions where learners either (1) close one activity to initiate a new one, or (2)temporarily suspend an ongoing activity and start a temporary one as an insertion sequence, are identified by investigating topic/activity change markers (Zemel, Xhafa, & Cakir, 2007). The Figure 9 below schematically represents the segmentation analysis.

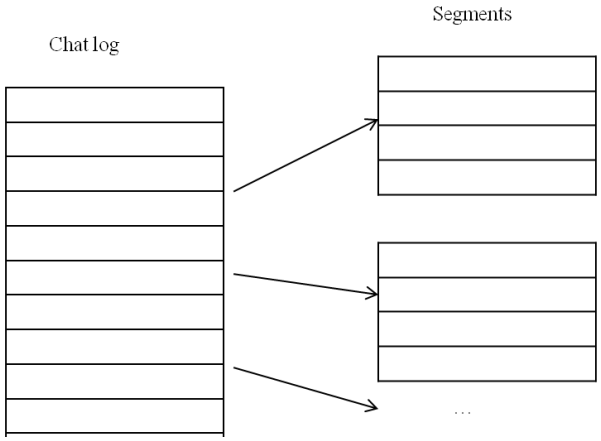

Figure 9. Representation of Segmentation Analysis

Based on the idea of segmentation analysis, we aimed to detect segments within the conversation, therefore focused on methods indicating the beginning of a new segment. In order to identify whole list of methods or conventions, we analyzed chat conversations and revealed frequent occurrences of words or phrases that typically appear at the beginning of segments or segment transition points (see Table 5). The methods consist of words and expressions that typically lead to transition between two successive segments. For instance, the most common way of initiating a new topic segment is proposing to work on a specific question. As other learners in the chat room take up this proposal by posting responses (e.g.

offering solution possibilities), a conversation gradually begins to develop on the newly proposed topic.

Table 5 Segment Starting Methods

Method	Description	Example Chat Messages
1	'hi', 'hello', 'welcome' is a single word anywhere in the posting	'hello friends' 'hi there'
2	'let', 'let`s' is a single word anywhere in the posting	'let's deal with part g'
3	'part', 'for' is followed by question item/number in a posting	'in part b we should do partial correlation, am i wrong?' 'so, for 1d'
4	'question', 'q' is a single word anywhere in the posting	'question e, we need sphericity test and normality tests results'
5	'I think' is a phrase anywhere in the posting	'I think the best way is that we plot histogram and make analysis'
6	'how about', 'what about', 'by the way' is a phrase anywhere in the posting	'how about the goal of the study?' 'what about the variables?' 'by the way about 1b, do you have any ideas?'
7	'move', 'proceed', 'next', 'continue', 'pass' is a single word anywhere in the posting, sometimes prefixed with a "so"	'so, we can move on to the outlier one' 'If you agree, we can pass to the second question'
8	'start', 'finish', 'stop' is a single word anywhere in the posting, typically prefixed with "let's"	'let's start from 3rd question ok?' 'let's stop here'
9	question item or number anywhere in the posting	'ok, f'

Nearly in all of the chat sessions, the conversation starts with the greetings exchanged among the team members. The words such as "hello" and "hi" are commonly used by the participants at the beginning of chat discussions. For instance, in the chat excerpt provided in Table 6, the communication started with the use of "hi all!" by H_A in the Line 9. Greetings continued until the message in line 16, hence messages between lines 9 and 15 formed the first segment of the chat conversation. After the greeting episode, the conversation continues to be shaped according to the theme and questions of the assignment. Learners exchange ideas and collaborate while providing solutions to different sections of the assignment. While shifting from a greeting to the question or from one question to the next, specific words and expressions emerged in chat messages that served transitional purposes. The use of the expression "first question" in the chat message "I looked at the first question" in line 17 exemplifies a segment initiation method in such a transitional sentence. In the following messages, learners of the team shared opinions and performed a collaborative investigation while offering solutions to questions of the assignment. In order to initiate the study on a question, learners usually refer to specific question sections or question numbers in their messages. For instance, the chat message "in part b we should do partial correlation, am i wrong?" can be employed to initiate a segment related to the solution of the question b. In some messages, rather than mentioning the question item, learners prefer to state the content

of the question while initiating a new segment. For example, the messages such as ‘how about the goal of the study?’ and ‘so, we can move on to the outlier one’ are used to initiate a segment related to the study goal and outlier detection correspondingly.

Table 6 Example Chat Excerpt

Line	Date	Post Time	User	Message	Segment
9	11.05.2013	11:21:03	H_A	hi all!	1
10	11.05.2013	11:21:05	Z_B	Hi	1
12	11.05.2013	11:21:28	Z_B	I hope you are all well	1
13	11.05.2013	11:26:49	H_A	yes and you	1
14	11.05.2013	11:27:03	Z_B	thank you, I am also good	1
15	11.05.2013	11:27:14	M_G	hi	1
16	11.05.2013	11:27:16	H_A	I looked at the first question	2
17	11.05.2013	11:27:23	Z_B	Ok	2
18	11.05.2013	11:27:33	H_A	I would like to explain my opinion	2
19	11.05.2013	11:27:33	Z_B	let’s start with the item a	2
20	11.05.2013	11:27:36	H_A	for first question	2
21	11.05.2013	11:27:45	H_A	Yes	2
22	11.05.2013	11:28:10	H_A	the minimum number for TOH 2^n-1	2
23	11.05.2013	11:28:27	H_A	2^n-1=7 for n=3	2
24	11.05.2013	11:28:56	M_G	yes, it is correct answer	2
25	11.05.2013	11:29:05	Z_B	I agree that it must be 7 for 3	2
26	11.05.2013	11:29:37	Z_B	do we need explain it in a more detailed way here? or is it enough?	2
27	11.05.2013	11:30:00	H_A	we may explain it in more detail	2
				…	

With the use of these methods, the focus of conversation may also change from a discussion on questions to social chit-chat or to a coordination episode where participants plan their next activity. The excerpt in the Table 7 is provided as an example to demonstrate such kind of a transition. For instance, H_A offered to terminate the chat session by posting a message like -“let’s give a break” in line 404. After this suggestion, he stated the reason of termination as being tired. The other learner (i.e. Z_B) also indicated the similar excuse in line 406. In the following conversation, the team scheduled their next meeting since there is a need for studying on remaining questions of the assignment. The conversations on social themes usually take shorter than the ones related to studies on questions and the chat session is ended quickly.

Table 7 Example Chat Excerpt

Line	Date	Post Time	User	Message
404	11.24.2013	14:08:35	H_A	let's give a break
405	11.24.2013	14:08:41	H_A	i am tired
406	11.24.2013	14:08:51	Z_B	me too, my mind froze, too
407	11.24.2013	14:08:50	H_A	i will look at tomorrow
408	11.24.2013	14:08:53	H_A	maybe all the day
409	11.24.2013	14:09:02	Z_B	ok see you tomorrow then
410	11.24.2013	14:09:00	H_A	Exactly
411	11.24.2013	14:09:06	H_A	Yes
412	11.24.2013	14:09:07	H_A	see you
413	11.24.2013	14:09:12	H_A	good night
414	11.24.2013	14:09:20	Z_B	have a good night, too

Research Question-2 – Which target concepts are discussed within the task-relevant segments of chat logs?

The process of detecting segments brings us to determine topics in a chat discussion. Each segment maps to a specific topic, which is generally related to the question of the assignment the learning group is working on. The chat topics are broadly categorized as task related and non-task related. Task related topics represent discussions of learning groups for the purpose of solving questions provided in the assignment. As an example, members of a learning group may exchange knowledge and ideas while trying to categorize variables in terms of their measurement scales. The other example can be the collaborative work of learners towards the interpretation of normality test results. The topics are treated as non-task related if the messages of the learners are about the coordination, socializing or sharing experiences in daily lives. Chat conversations may flow on different task related topics, and non-task related issues may appear between task related topics. The organization of chat topics unfolds in parallel to the social dynamics of the learning group.

In our chat data, topics of task related segments were shaped according to themes extracted from the questions. In order to identify the topics of segments, we aimed to consider keywords that the teams employed while solving questions of the assignments. For this purpose, we initially employed two mode network analysis to find whole terms that the teams utilized while collaboratively solving each question under each assignment. For instance, the two network provided in the Figure 10 demonstrates all terms used by three teams while solving the question-c of assignment-1. In this network, the purpose is to demonstrate the relation between two types of nodes such as teams and terms. Nodes for the teams are located at the center and nodes representing the terms are located around the network. A link is added between a team node and a term node if this term is used by the team. The weight of the link demonstrates the number of occurrences of the term in the conversation of the team.

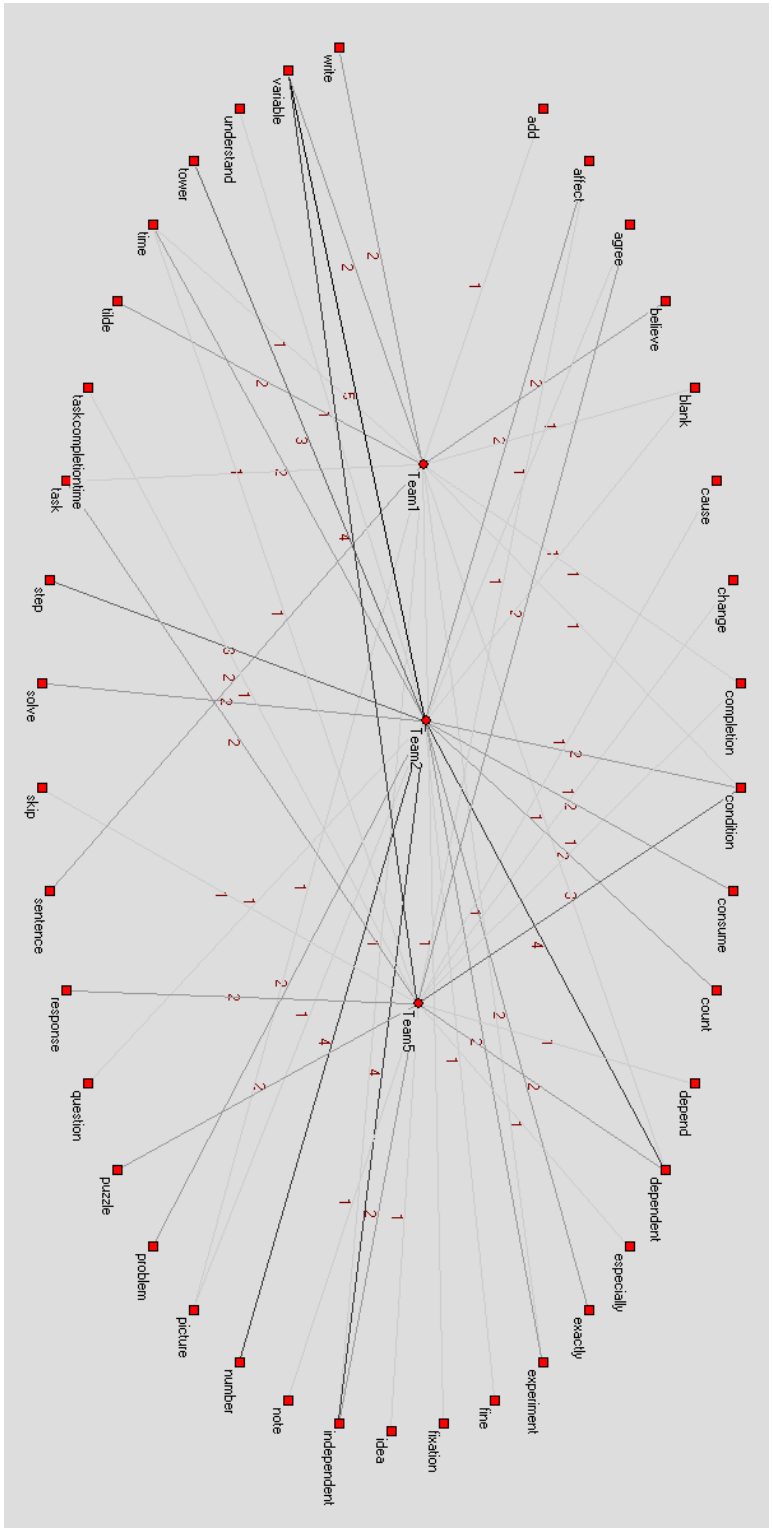

Figure 10. Terms Used by Three Teams While Solving the Question-c of Assignment-1

We transformed each two mode network to a corresponding one mode network in order to reveal the mutual words used by the teams while working on a solution for the question. For instance, when we transformed the network in Figure 10, we obtained the following one mode network (see Figure 11), which shows the mutual words utilized for the solution of the question-c of assignment-1. The mutual words were detected as condition, dependent, independent, time, and variable, which are as a result identified as indicative terms of the question-c of assignment-1. In the same manner, we identified indicative words for each question in all seven assignments.

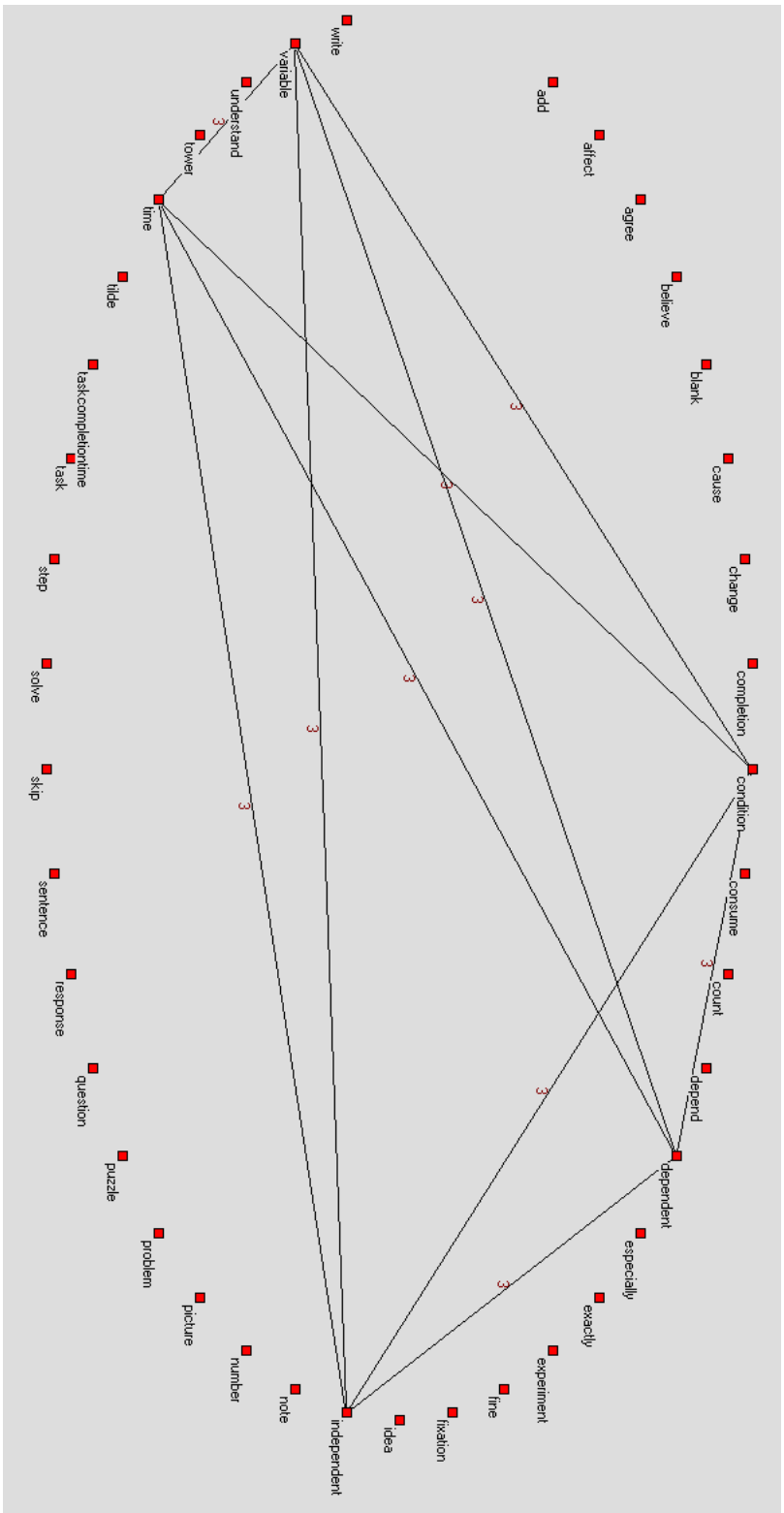

Figure 11. Mutual Words Utilized for the Solution of the Question-c of Assignment-1

In order to explore which segment maps to which question, we aimed to compare text of each segment (Sn) with indicative terms of each question (Qn). For this purpose, we employed the latent semantic analysis (LSA) method to find the most likely mappings between segments and questions in terms of their semantic similarity.

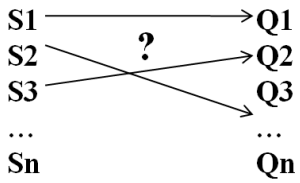

Figure 12. Comparison of Segments and Questions

LSA is defined as "a fully automatic mathematical/statistical technique for extracting and inferring relations of expected contextual usage of words in passages of discourse." (Landauer, Foltz, & Laham, 1998, p. 8).LSA is based on the assumption that words that have a similar meaning tend to be located in similar pieces of texts in terms other words they tend to be co-located with. In order to apply LSA, a series of steps are applied.

In the first step, a term-document matrix is constructed that its rows indicate the vectors of all terms appeared in documents and its columns indicate the vectors of all documents. The whole term-document matrix can be represented by a matrix *A*, with *m x n* dimensions, pointing to terms and documents respectively. Each cell value can be represented as *A[i, j]=a* that the i^{th} term occurs in the j^{th} document for *a* times. In addition, *B* and *C* matrices can be generated from the *A* matrix. *B* matrix is the document-document ($m \times m$) matrix that consists of the number of common words in documents, and *C* matrix is the term-term ($n \times n$) matrix that demonstrates the number of documents in which terms appear together.

As a next step, singular value decomposition (SVD) is applied to the *A* matrix:

$$A=S\Sigma U^{T}$$

Where the *S* matrix consists of the eigenvectors of matrix *B*, the *U* matrix consists of eigenvectors of *C*, and the Σ matrix consists of the singular values acquired as square roots of the eigenvalues of the *B* matrix. Some of the singular values are neglected and replaced with 0 when they are too small. In other words, *k* singular values are kept in Σ and it is reduced to a Σ_k matrix. In parallel to this transformation, *S* and U^T are reduced to S_k and U_k^T matrices respectively, and the matrix *A* is approximated as follows:

$$A_k=S_k\Sigma_k U_k^{T}$$

After this transformation, documents and terms gain new representations. Documents are represented through column vectors - $\Sigma_k U_k^T$ and terms are represented through row vectors - $S_k\Sigma$.

We employed the lsa package of the R tool (Wild, 2015) to apply the LSA analysis to our data. Considering the teams' collaborative studies in each assignment, we respected each chat segment, and each question including indicative terms as a separate document (*dn*). In the preprocessing stage, we eliminated numbers, punctuation signs and stop words from texts

of segments with the help of the R tool. Then, we generated a term document matrix in which the term axis contains all the words involved in the documents and the document axis contains all the documents (i.e. segments and questions). The values in the matrix demonstrate the number of times that terms occur in the documents. For example, we generated the following matrix in Figure 13 for the chat segments of team-1 and the question documents in the context of assignment-1.

	Documents										
Terms	Q1a	Q1b	Q1c	Q1c2	Q1d	Q2a	s3	s4	s5	s6	s10
answer	0	0	0	0	0	0	0	0	0	0	1
categorical	0	0	0	0	0	0	0	0	0	1	0
chart	0	0	0	0	0	1	0	0	0	0	0
collect	0	0	0	0	0	0	0	1	0	0	0
condition	0	0	0	0	0	0	0	1	1	0	2
data	0	0	0	0	0	1	0	1	0	0	3
dependent	0	0	0	1	0	0	0	0	1	0	1
descriptive	0	0	0	0	0	1	0	0	0	0	0
design	0	0	0	0	0	0	0	1	0	0	0
experiment	0	1	0	0	0	0	0	2	0	0	0
…											

Figure 13. Chat Segments of Team-1 and the Question Documents in the Context of Assignment-1

In the matrix, column values demonstrate the vector forms that belong to the corresponding documents. By applying the SVD, we obtained the finalized vector forms of the documents. Then, in order to find the semantic similarity between a segment and a question, we computed the cosine similarity between their finalized vectors by using the following formula:

$$\frac{d_i . d_j}{|d_i||d_j|}$$

For instance, we found the following cosine similarity values in Table 8 for chat segments of team-1 and the question documents in the context of assignment-1.

Table 8 Cosine Similarity Values

	s3	s4	s5	s6	s10
Q1a	0.99	0.00	0.00	0.00	0.00
Q1b	0.03	0.97	-0.01	-0.01	0.00
Q1c	-0.08	-0.02	0.86	0.65	0.19
Q1c2	-0.18	0.42	0.90	0.34	0.15
Q1d	-0.16	0.51	0.00	0.86	0.00
Q2a	0.00	0.08	0.00	0.00	0.31

As it can be observed in the Table 8, cosine values range from -1 to 1. The values close to 1 demonstrate high degree of semantic similarity between the documents. According to this evaluation, we can conclude that segment3 maps to Q1a, segment4 maps to Q1b, segment5 maps to Q1c, and segment6 maps to Q1d with high cosine values. In addition, we found the mapping of s10 to Q2a, with an average cosine value.

Research Question-3 - How learners accomplish conceptual development during their collaborative study in chat environments?

Once a learning session is completed, the instructor or a collaborative learning system designer will expect to learn whether the session is effective or not for the learners, and what instructional benefits the learners obtain during the session. In the context of collaborative learning, the benefits learners acquire are based on their interaction in the group. In order to reveal instructional benefits, researchers gather the protocol data of the session, identify cores of the data and investigate the benefits in the data (Inaba, 2002).

We aimed to inspect the verbal interaction among learners by considering their knowledge construction process in the VMT system while discussing assignment related content. We considered knowledge construction as a social and dialogical process where student participation is highly important. We employed sentences of messages as the unit of analysis and also investigated them according to the Progressive Knowledge Building Inquiry cycle (Hakkarainen, 2003; White & Frederiksen, 1998), which starts with a trigger activity and consists of four main phases; (a) idea generation, (b) idea connection, (c) idea improvement, and (d) rise above. Trigger activity generally consists of the question statement that encourages students to provide ideas and solutions. The phases are defined in the following way (So et al., 2010):

- **Idea generation:** In this phase, learners generate ideas or questions related to the theme or topic. In other words, during the collaborative activity, students provide their ideas and corresponding reasons for the solutions of questions.
- **Idea connection:** The initial idea generation continues with learners' comparison and compare of diverse ideas for the idea connection.
- **Idea improvement:** Learners' search of new information and knowledge results in idea improvement phase.
- **Rise above:** This phase is related to learners' reflections about their own learning. More specifically, "students think about what they have learnt, how this new knowledge has helped them in answering their initial questions about the theme or topic of study, and what new perspectives of knowledge has been built from the activities" (So, et.al, 2010, p. 482).

As stated in the course section, assignments cover standard statistical methods. Some concepts such as identification of independent/dependent variables, and their scale of measurement, checking parametric assumptions (i.e. normality and homogeneity of variance), the notion of null hypothesis and statistical significance, and applying the statistical test were common to all online activities due to their central role in statistical analysis. Developing a deep understanding of each of these concepts were targeted as learning goals of the course. Our study focuses on learners' progress in key dimensions during the entire term, namely identifying variables and their measurement scales, checking

normality of data and performing statistical tests together with checking assumptions of these tests. Therefore, we focus on the sequential organization of chat messages and whiteboard actions in that episode to observe how learners referred to and made use of these concepts.

Research Question-4 How are the contents of chat discussions and wiki postings relate to each other?

The Wiki documents constituted the final deliverable submitted by the team, so its content is organized to be read as a summary of the team's findings. Wiki output is typically organized in alignment with the organization of the questions listed in each assignment. Therefore, each wiki segment directly maps to a question of an assignment. For the analysis of the wiki content, we employed the content analysis approach and aimed to identify the sufficiency of the content as a proposed solution for the question.

After identifying the segments in which learners' discussed a specific solution to a question in the chat environment, we investigated the final solution in the wiki, hence we could make comparisons among them. We compared the wiki content with the solutions proposed in the chat environment, hence explored the additions or removals in the finalized solution. While some decisions made in the chat environment are directly reflected to the wiki content, some additions or removals can be done in wiki content in comparison to chat discussions.

In the next analysis of wiki content, we focused on correctness of the solution. We checked the solution and identified if it is completely correct, partly correct or incorrect. When the solution is partly correct or incorrect, we reported the insufficient parts.

Progress of Teams throughout Assignments

In the final stage, we analyzed learners' progress in chat environment according to common concepts of assignments. We identified these concepts as variables and normality test. We investigated progress of both teams and individual learners throughout assignments. In order to demonstrate the progress, we compared learners' current solutions with the ones provided in prior assignments. If the team or learner achieved progress in later assignments according to earlier ones, we indicated this as progress. If the problem experienced in earlier assignments continue until the last ones, we categorized the problem as unsolved and failure of the team or learner.

According to the same concepts (i.e. variables, and normality test), we examined learners' solutions and grades in midterm and final exams. As the final step, we analyzed if the successful or unsuccessful points in chat environment were reflected to learners' solutions in the exam questions in the concepts we identified as the common ones in assignments.

Research Question-5 How are the process measures devised by learning analytics methods and the measures for overall learning outcomes relate to each other?

To address this question we investigated the relationship between process measures devised from the learning analytics methods developed in this study and the final grades obtained by individuals from the course via conventional exams.

CHAPTER-4

RESULTS

In this section, we provided the results produced for the team-1, organized according to the research questions of the study. Results of the research question 3 and research question 4 were provided in the same section since chat and wiki contents demonstrate contiguity and the wiki output is analyzed after the related chat excerpt in reference to the task description. We provided the results of team-2 and team-5 in the Appendix section.

RESULTS FOR THE TEAM-1

Research Question-1 - Which segments of chat logs reflect learners' collaborative studies on assignments?

In the chat log of each assignment, we detected segments by employing previously constructed starting methods. The team has performed several online chat meetings, hence various segments were produced during these sessions. The segments mainly consist of learners' discussions related to the requirements of the assignment as well as issues of coordination. Yet, we consider segments related to the learners' studies in solving the given questions in order to reveal the teams' studies and progress related to the major concepts of the course. The Table 9 demonstrates the number of task related segments detected in 7 assignments for team-1.

Table 9 Team-1's Task Related Segments

Assignment	Number of Detected Task Related Segments
1	5 (s2, s4, s5, s6, s10)
2	9 (s3, s7, s9, s14, s16, s17, s21, s23, s24)
3	5 (s2, s4, s5, s7, s8)
4	6 (s3, s6, s8, s9, s14, s16)
5	5 (s2, s3, s5, s6, s8)
6	12 (s2, s4, s6, s7, s9, s11, s18, s20, s23, s25, s27, s28)
7	6 (s2, s3, s4, s6, s7, s8)

The number of segments is different for assignments. In the first assignment, we totally detected 5 segments. As an example, we provided the contents of its first three segments as follows.

Segment-2

Line	Date	G_C	Y_A	A_S
40	11/7/2013			All the experiments need minimum 7 steps for solution
41	11/7/2013	Yes		

Segment-4

Line	Date	G_C	Y_A	A_S
45	11/7/2013			The design of the study is experimental
46	11/7/2013	No objections		
				Data were collected experimentally from randomly selected participants
47	11/7/2013	i think before we move on to c, maybe we can add: "since the fixation times are recorded and the responses are discussed under three conditions for each task, at least one variable is manipulated." would that be ok?		
48	11/7/2013			can we expand my last part G_C?
49	11/7/2013			sure... you mean this for part b?
50	11/7/2013	Yes		

Segment-5

Line	Date	G_C	Y_A	A_S
64	11/7/2013			what about the variables?
65	11/7/2013	task completion time is dependent;		
66	11/7/2013	right?		
67	11/7/2013			I think the same, so lets you add it by 4 tildes :)
68	11/7/2013	ok :)		
69	11/7/2013	maybe i should tilde up the sentence I just wrote?		
70	11/7/2013			before the sentence I think
71	11/7/2013	how about the independent variables?		
72	11/7/2013			experiment condition?
73	11/7/2013			picture, blank, fixation
74	11/7/2013	well yes, i believe		
75	11/7/2013			I believe so :) Ok I write it
76	11/7/2013	:)		

The teams' total number of task related on non-task related segments are provided in the Table 10. According to the results, 44% of total segments were filtered since they are non task related.

Table 10 Distribution of Segments

Team	Number of task related segments	Number of non-task related segments
1	48	51
2	37	15
5	74	64
Total	159 (%56)	130 (%44)

Research Question-2 –Which target concepts are discussed within the task-relevant segments of chat logs?

The next chat processing step aims to explore key concepts that the team has employed during their online collaborative studies. For this purpose, we mainly focused on segments that reflect the efforts of the members for answering the questions of the assignment.

In our chat data, topics of task related segments were shaped according to the themes of the questions. In order to identify the topics of each segment, we aimed to consider the keywords that the teams employed while solving the relevant question of the assignments. For this purpose, we employed the two mode network analysis approach to find the whole terms that the teams utilized while collaboratively solving each question in the assignment (see Section 3.5.2). Among these words, we considered the common ones used by three teams. In the Table 11, we provided the keywords that we detected for questions about which teams performed a collaborative chat activity. For the remaining questions we couldn't produce keywords since the teams didn't discuss those questions during their chat sessions.

Table 11 Keywords Detected for Questions of Assignments

Assignment-1	Keywords
1a	Minimum, number, question
1b	Experiment, participant, study, variable
1c	Goal, problem, time, condition, dependent, independent
1d	Nominal, ratio, variable
2a	Chart, data, descriptive, frequency, graph, split, value
2b	Descriptive, histogram, plot, toh
2c	Condition, data, distribute, group, mean, normally, normality, picture, puzzle, result, sigma, significant, split, toh, value
2d	Outlier, detection
2e	Log, transformation

Assignment-2	Keywords
1	Brain, fit, heavy, interval, ratio, variable, volume, weather, winter
2	Normality, table, test
3a	Bivariate, correlation, mean, mrivolume, partial, pearson, square, sum, weight
3b	Coefficient, correlation, height, positive, time, total, weight
4b	Fit, graph, significance, significant
4d	Residual

Table 11 (cont.)

4e	Fit, line, part
4f	Model, mrivolume, predictor, value

Assignment-3	Keywords
a	age, baseline, fit, mean, predict, significance, statistic, table, value, variable
b	equation, model, number, predict
c	answer, classification, table, wrong
d	category, constant, contribution, equal, odds, outcome, predict, ratio, significance, statusquo, variable, wald
e	affect, age, odds, predictor, probability
f	association, confidence, interpret, interval, model, odds, positive, predict, probability
g	cooks, dfbeta, distribute
h	independent, multicollinearity

Assignment-4	Keywords
1	dependent, independent, measure, post, time
2	analysis, dependent, distribution, nonsignificant, normal, normality, posttest, pretest, theorem, variance, variable, homogeneity, levene, post, test
3	anova , difference, group, hypothesis, reject, significance
4	anova, difference, enter, mean, significance, table, test
5	difference, group, mean, normality, paired, posttest, pretest, ttest

Assignment-5	Keywords
a	dependent, independent, mood, stoprule, variable
b	factorial, independent, measure, mood
c	anova, assumption, data, distribute, kolmogorov, listcount, normality, normally, parametric, positive, result, separately, test
d	box, effect, mean, step
e	hoc, post, result

Assignment-6	Keywords
a	data, understand
c	condition, dependent, factor, independent, measure, variable
d	condition, effect, experiment, order, participant
e	assumption, difference, graph, mauchlys, normal, normality, parametric, significance, substantial, variance
f	condition, grand, mean, score, separate, ssb, sst
g	comparison, effect, eta, partial
h	anova, friedman, significant

Assignment-7	Keywords
a	dependent, experiment, independent, list, score, variable
b	assumption, box, dependent, equal, homogeneity, levene, manova, normality, sample, significant, test, time, variable, dependent, explore, list, normal, normality, year
c	covariance, look, multivariate, pillai, test
d	anova, bonferroni, contrast, dependent, difference, error, group, hoc, manova, post, posthoc, significant, sphericity, tukey, variance
e	range, variate, year

In order to explore which segment maps to which question, we compared each segment (sn) with keywords of each question (qn). For this comparison, we applied the latent semantic analysis (lsa) to compute the semantic similarity between the two types of lists. The LSA results demonstrate the cosine similarity between segments and questions. The value of cosine similarity changes from 0 to 1. The values near to 1 show a higher level of similarity between the segment and the question. In this way, we can explore which chat segment relates to which question statement. The Table 12 demonstrates the match that we found among segments and questions of assignments. For the majority of segments, we could correctly find the corresponding questions. Only for three segments, our LSA analysis couldn't match them with the correct questions.

Table 12 Team-1's Segments and Matching Questions

Assignment1												
Segment	s2	s4	s5	s6	s10							
Question	1a	1b	1c	1d	2a							
Assignment2												
Segment	s3	s7	s9	s14	s16	s17	s21	s23	s24			
Question	1	2	3a	3a	3b	3b	4b	4d	4e			
Assignment3												
Segment	s2	s4	s5	s7	s8							
Question	b			a	b							
Assignment4												
Segment	s3	s6	s8	s9	s14	s16						
Question	1	2	2	2	3	4						
Assignment5												
Segment	s2	s3	s5	s6	s8							
Question	a		b	c	c							
Assignment6												
Segment	s2	s4	s6	s7	s9	s11	s18	s20	s23	s25	s27	s28
Question	d	d	d	e	d	e	g	g	G	f	g	h
Assignment7												
Segment	s2	s3	s4	s6	s7	s8						
Question	a	b	b	b	c	c						

According to the results in the table, we could identify topics discussed in segments by investigating the focus of questions. Table 13 below demonstrates concepts that team-1 discussed in segments of each assignment.

Table 13 Team-1's Segments and Matching Concepts

Assignment1's Segments	Topic Discussed
s2	Steps of the experiment
s4	Design of the study
s5	Variables and goal of the study
s6	Scales of variables
s10	Descriptives

Assignment2's Segments	Topic Discussed
s3	Design of the study
s7	Descriptives and Test of Normality
s9	Correlation

Table 13 (cont.)

s14	Correlation
s16	Correlation
s17	Correlation
s21	Model Fit
s23	Residual
s24	Regression

Assignment3's Segments	Topic Discussed
s2	Model Equation
s7	Model Fit
s8	Model Equation
Assignment4's Segments	Topic Discussed
s3	Variables
s6	Assumptions
s8	Assumptions
s9	Assumptions
s14	Statistical test
s16	Statistical test

Assignment5's Segments	Topic Discussed
s2	Variables of the Study
s5	Design of the study
s6	Assumptions of Anova
s8	Assumptions of Anova

Assignment6's Segments	Topic Discussed
s2	Counterbalancing
s4	Counterbalancing
s6	Counterbalancing
s7	Assumptions of Anova
s9	Counterbalancing
s11	Assumptions of Anova
s18	PostHoc Test
s20	PostHoc Test
s23	PostHoc Test
s25	Applying Anova
s27	PostHoc Test
s28	Nonparametric Test

Assignment7's Segments	Topic Discussed
s2	Variables of the Study
s3	Assumptions of Manova
s4	Assumptions of Manova
s6	Assumptions of Manova
s7	Multivariate Tests
s8	Multivariate Tests

Research Question-3- How learners accomplish conceptual development during their collaborative study in chat environments?

Research Question-4- How are the contents of chat discussions and wiki postings relate to each other?

Once the relevant excerpts are obtained through segmentation and LSA we focus on the interactional content where the "variables", "normality test" and "statistical test" concepts were discussed by the team. We particularly focused our analysis of knowledge building episodes on these concepts due to their fundamental importance in statistical reasoning. Our purpose is to understand how learners made progress throughout chat activities while working on these concepts. We employed Progressive Knowledge Building Inquiry Cycle (So, et al., 2010) as a conceptual framework to situate our analysis of the excerpts within knowledge building theory. Additionally, wiki content was investigated to reveal reflection of chat activities as wiki content.

VARIABLES CONCEPT

Assignment-1
Dependent and Independent Variables

The team's discussion related to the concept of variables was initiated with the question of A_S in line 64 for the purpose of identifying variables in the study. As a response, G_C focused on the type of dependent variable and proposed that the task completion time fits in this type (line 65). Since the question consists of an experiment that investigates effects of three conditions on participants' task completion time and responses, G_C categorized the task completion time correctly. In order to be sure about her suggestion, G_C asked opinions of other members (line 66). A_S thought similarly and advised G_C to share this idea in the whiteboard area by indicating her contribution to this question (line 67). However, this solution was missing since the response should be considered as the other dependent variable.

Line	Date	Post Time	Chat Message / Whiteboard Activity
64	11.07.2013	5:52 PM	A_S: what about the variables?
65	11.07.2013	5:53 PM	G_C: task completion time is dependent;
66	11.07.2013	5:53 PM	G_C: right?
67	11.07.2013	5:54 PM	A_S: I think the same, so lets you add it by 4 tildes :)
68	11.07.2013	5:54 PM	G_C: ok :)
			G_C wrote the dependent variable to the textbox in the whiteboard
71	11.07.2013	5:57 PM	G_C: how about the independent variables?
72	11.07.2013	5:57 PM	A_S: experiment condition?
73	11.07.2013	5:58 PM	A_S: picture, blank, fixation
74	11.07.2013	5:59 PM	G_C: well yes, i believe
75	11.07.2013	6:00 PM	A_S: I believe so :) Ok I write it
			A_S wrote the independent variables to the textbox in the whiteboard

Analysis of the messages between lines 64 and 68 according to the Progressive Knowledge Building Inquiry cycle results in the following interpretations. First message (line 64)

consists of the question (i.e. variables) and can be considered as a trigger activity that encourages members to generate ideas about the variables. In the message in line 65, G_C proposed "task completion time" as a dependent variable, which reflects the activity in the phase of *idea generation*. In the line 67, A_S indicated his agreement related to this idea.

The members decided to tag their solutions with their names in order to inform the instructor about their individual contributions to the assignment. Hence, by indicating her name after the solution, G_C wrote that "task completion time is dependent" to the textbox, which was previously developed by the team in the whiteboard environment.

After specifying the dependent variable, G_C expected to detect independent variables (line 71). As a suggestion, A_S indicated that the experiment conditions (i.e. picture, blank, fixation) are in independent category (line 72,73) and G_C approved this idea (line 74).This was a correct and complete solution of the team since the experiment focuses on effect of conditions on participants' task completion time and responses. Therefore, conditions should be respected as independent variables. In parallel to the group's decision, A_S offered to share the solution (line 75) and reported that "Independent variables are the experiment conditions, namely, picture, blank and fixation" in the whiteboard area.

As in the messages in lines from 64 to 68, the group performed in the similar manner between lines 71 and 75 according to the Progressive Knowledge Building Inquiry cycle. In the message in line 71, G_C asked the question (i.e. independent variables), hence expected from members to generate appropriate solutions. In the messages in line 72 and 73, A_S provided his idea by indicating experiment conditions as independent variables, which represents the phase of *idea generation*. In lines 74 and 75, members provided confirmations regarding the idea.

Wiki Reflection

The wiki output covered the team's whole decisions in the chat environment related to the variables concept. As decided in the chat, G_C reported the dependent and independent variables that "The task completion time is the dependent variable. Independent variables are the experiment conditions, namely, picture, blank and fixation. The puzzle type is another independent variable."

Scales of Variables

The team's discussion came to gain an understanding about scales of variables, which were identified in the previous discussion. G_C specified her thought that the task completion time is on ratio scale (line 79). A_S approved this idea and suggested G_C to share it in the whiteboard environment (line 82). G_C attempted to report the solution and provide appropriate rationale for the scale of the task completion time. That is, G_C shared the interpretation that "the task completion time is measured on the ratio scale since it is the response time that is shown in milliseconds." The reasoning was not actually suitable for the ratio scale. G_C attempted to provide additional justification but stated that she couldn't find the online content explaining the scales of measurement (line 83). Therefore, A_S stated that he could wait while G_C was searching for the content (line 84). After a while, G_C shared the further interpretation that "each response says something about the performance of each participant under a certain condition" in the whiteboard area and indicated the completeness of the interpretation (line 86). Actually, the interpretations provided by G_C do not reflect the reasoning related to the ratio variables. She could mention the representation of equal intervals in the scale and the existence of meaning related to the ratio of values.

Line	Date	Post Time	Chat Message / Whiteboard Activity
79	11.07.2013	6:04 PM	G_C: for part d, i think task completion time is on ratio scale.
82	11.07.2013	6:04 PM	A_S: Okey, you write it then :)
			G_C wrote "The task completion time is measured on the ratio scale since it is the response time that is shown in milliseconds" to the whiteboard
83	11.07.2013	6:10 PM	G_C: I will add my justification in a minute. I just lost the slides that explains the scales of measurement
84	11.07.2013	6:10 PM	A_S: okey... I'm waiting
85	11.07.2013	6:10 PM	G_C: ok
			G_C continued to add justification by writing "each response says something about the performance of each participant under a certain condition." to the whiteboard
86	11.07.2013	6:11 PM	G_C: i think it's ok now
87	11.07.2013	6:12 PM	G_C: what about the other variables?
88	11.07.2013	6:17 PM	A_S: independent variables are in nominal scale? they are ordered in numbers
89	11.07.2013	6:19 PM	G_C: yes, definitely, moreover i think we can even take the puzzle group here since they are also categorical ??
92	11.07.2013	6:19 PM	A_S: Okey..your are right...
			G_C wrote "The independent variables are all measured on the nominal scale since they display categories." to the whiteboard

Next, G_C solicited her team members' ideas regarding the scales of other variables (line 87). A_S responded that independent variables are measured in nominal scale since they are ordered in numbers (line 88). G_C agreed with this offer and also proposed to consider puzzle group in nominal scale since they consist of some categories (line 89). Similarly, A_S confirmed the idea of G_C (line 89). Then, G_C shared the solution in the whiteboard by writing "The independent variables are all measured on the nominal scale since they display categories."Although the final solution was correctly presented in the whiteboard area, one could criticize A_S's initial argument that nominal scale refers to a variable ordered in numbers seems to be misguided, since the proper reasoning should refer to the existence of more than two categories.

In terms of Progressive Knowledge Building Inquiry cycle, some of the messages between lines 79 and 92 were detected to exist in idea generation phase. In the messages in lines 79, 88, and 89, the team provided answers and a line of reasoning for identifying the scale of a variable, hence they are considered in the phase of *idea generation*. The messages in lines 82, 89 and 92 demonstrated agreements to the ideas offered.

Wiki Reflection

Regarding the scales of variables, G_C shared the solution that "The task completion time is measured on the ratio scale since it is the response time that is shown in milliseconds and each response says something about the performance of each participant under a certain condition" and A_S reported the statement that "The independent variables are all measured on the nominal scale since they display categories."

Assignment-2

Scales of Variables

At the beginning of the discussion, the team was generating ideas for the scales of variables. Initially, G_C proposed the gender in binary and IQ variables in ratio scales (line 25). Although the categorization for the gender was correct, iq variables should be grouped as interval scale. This is because the iq variable consists of equal intervals but not ratios along the scales.

Line	Date	Post Time	Chat Message / Whiteboard Activity
25	11.13.2013	4:55 PM	G_C: and gender is binary, whereas all IQ variables are ratio
26	11.13.2013	4:55 PM	Y_A: gender is nominal.
27	11.13.2013	4:55 PM	Y_A: brain volume, body height and body weight should be ratio variables as well.
28	11.13.2013	4:57 PM	G_C: yes. i will try to justify the reasons, and you'll correct me if i'm wrong.
29	11.13.2013	5:05 PM	G_C: excuse me, Y_A, would it be wrong if i say brain volume, height and weight are interval variables? I couldn't decide, i also thought they were ratio at first, but then, since they are measured at scales like cm and kg, maybe interval would also be the answer??
30	11.13.2013	5:13 PM	Y_A: a variable is a ratio variable if you can say this: "the subject with value 2x is twice as whatever as the subject with value x".
31	11.13.2013	5:13 PM	Y_A: for example, we can say "the subject weighing 100 kg is twice as heavy as the subject weighing 50 kg"
32	11.13.2013	5:13 PM	Y_A: so weight is a ratio variable.
33	11.13.2013	5:14 PM	Y_A: you can say it with height as well.
34	11.13.2013	5:14 PM	Y_A: for example, you can't say it with Fahrenheit degrees. 50 degrees Fahrenheit is not half as hot as 100 degrees Fahrenheit.
35	11.13.2013	5:14 PM	Y_A: As a general rule, interval variables which start at 0 are ratio variables.
36	11.13.2013	5:15 PM	Y_A: (Fahrenheit starts at 32 degrees)
37	11.13.2013	5:17 PM	G_C: ok, thank a lot for the clarification :)

In comparison to the proposition of G_C, Y_A offered that the gender is measured in nominal scale, which actually should be in binary scale since there are two categories; male and female (line 26). The correct answer was offered by G_C in the previous utterance (line 25).Then, Y_A proposed the brain volume, body height and body weight as ratio variables (line 27). G_C didn't state anything about the difference of their offers for the scale of gender, but focused on the idea of Y_A related to the scales of brain volume, body height and body weight. Therefore, G_C stated that she would begin to share concerns about this topic (line 28). That is, G_C asked if brain volume, body height and body weight can be considered as interval scale variables. G_C provided explanation that she initially thought these variables fit to ratio variable, but then changed her mind. She provided the reason of

the change is that the use of cm or kg measures in these variables makes them in interval scale. Yet, she again experienced confusion and asked for the opinions of team members (line 29). G_C's misperception about the ratio variables was also observed while she was providing interpretation in the Assignment-1. Since she couldn't provide appropriate rationale for the ratio variable, guidance needs to be provided by her team members.

In order to facilitate understanding of G_C, Y_A proposed to consider a variable in ratio scale "if the subject with value 2x is twice as whatever as the subject with value x" (line 30).Additionally, Y_A attempted to provide appropriate examples. Initially, he focused on the weight variable and stated that "the subject weighing 100 kg is twice as heavy as the subject weighing 50 kg" (line 31). Therefore, he suggested considering the weight in ratio scale (line 32). Then, he stated the similarity between weight and height variables, hence offered the ratio as appropriate scale for the height (line 33). In the next conversation, Y_A provided the Fahrenheit degree as a counter example for the ratio scale. He provided the justification that 50 degrees Fahrenheit is not half as hot as 100 degrees Fahrenheit (line 34). Y_A suggested to produce a general rule, hence stated that interval variables which start at 0 can be considered as ratio variables (line 35). Then, Y_A decided to clarify the structure of Fahrenheit variable by stating that it starts at 32 degrees (line 36). After the explanations of Y_A, G_C stated her understanding and satisfaction in line 37.

Analysis of the messages between lines 25 and 37 according to the Progressive Knowledge Building Inquiry cycle leads to the following interpretations. The messages in line 25, 26, and 27 are considered to be in *idea generation* phase since members provided their ideas about the scales of variables- gender, IQ, brain volume, body height, and body weight. In the line 29, G_C compared her idea with the previous one and provided a different idea about the scale of brain volume, body height, and body weight. Therefore, this message is both related to *idea generation* and *idea connection* phase. In that message, G_C thought that the variables should be characterized as interval instead of ratio scale. Actually, this represented the misconception of G_C about the difference between ratio and interval variables. In order to remedy this misconception, Y_C provided appropriate explanations and examples between lines 30 and 36. These messages demonstrated the *idea improvement* since they consist of further explanations and samples about the ratio and interval scales.

Wiki Reflection

The group's wiki delivery has some differences in comparison to the content of their chat discussion. For the type of gender, G_C shared the wiki submission that "Gender variable is a binary variable since there are only two alternatives on the nominal scale: male or female." G_C had categorized the gender as binary in the chat, and this solution appeared in the wiki output.

For the type of remaining variables (i.e. brain volume, body height and body weight), G_C reported that "all the other variables are ratio. If one score is higher than the other, then, this would indicate that when compared to the other participant(s), the participant did better in the test/is taller/ weights more than other participant(s)." The type of ratio scale for these variables had already been decided in the chat environment, which was correct solution. However, during the chat discussion Y_A had provided more appropriate explanations for the ratio variable. Thus, in the wiki output, the team could explain existence of the ratios

along the scales, and occurrence of a true and meaningful zero in order to provide appropriate reasoning for the ratio variable.

Assignment-4

A_S initiated the discussion about the "variables" concept with his remark in line 33, possibly in response to the first question in the assignment. This is taken up by G_C in line 34, where she proposed the test scores as the dependent and the group categories as the independent variables. She also proposed that test scores are measured at the ratio level and group is a nominal-categorical variable. In the next line, Y_A agreed with G_C. At the same time, Y_A indicated his idea about the pre-test data by categorized them as awful scores (line 36). G_C shared the same idea with Y_A and stated that there is a great difference between pre-test and post-test scores (line 37). After these comments, A_S indicated his agreement to the ideas of team members (line 38).

Line	Date	Post Time	Chat Message / Whiteboard Activity
33	12.09.2013	12:47 AM	A_S: we can start to discuss dependent and independent variables and the level of scale
34	12.09.2013	12:49 AM	G_C: i think Pre test and Post test are dependent (ratio) ; method groups are independent (nominal-categorical) variables.?
35	12.09.2013	12:51 AM	Y_A: That is exactly my opinion too.

The team quickly came to an agreement around G_C's proposal. Note that this was the team's fourth assignment where they answered similar questions for the previous assignments. Coming to an agreed answer for the same question took more time and turns in those previous cases, so the team seemed to have progressed in detecting and categorizing variables involved in a given research design description. However, one could criticize the argument that test scores are measured at the ratio scale, since a score of 0 does not necessarily imply absence of reading comprehension skills.

The messages between lines 33 and 35 can be analyzed based on the Progressive Knowledge Building Inquiry cycle as follows. Initial message (line 33) indicates expectation of the question (i.e. variables and their scales) and can be respected as a trigger activity that encourages members to generate ideas. In the next message, G_C provided the answers related to types and scales of variables, hence illustrated the activity in the phase of *idea generation*. The last message of Y_A consists of comparison and agreement towards to idea of G_C.

Wiki Reflection

According to the wiki logs, G_C wrote the results about variables as follows: "Pre test and Post test are dependent (ratio); method groups are independent (nominal-categorical) variables." This output completely reflected the group's decision in the chat environment. Although big portion of the solution was correct, the ratio scale assigned to test scores should be changed to interval scale. This is because, there are equal intervals along scales and a score of 0 does not refer to the absence of reading comprehension skills.

Assignment-5

Dependent and Independent Variables

After reviewing the assignment, G_C expected confirmation for the existence of two independent variables: stop_rule and mood (line 17, 19). As a response, A_S stated that he had the same idea with G_C (line 20). Since the question presents an experiment that investigates influence of stop_rule and mood on number of items that obsessive compulsive disorder (OCD) patients' check before leaving the home, the solution of the group was correctly provided.

Line	Date	Post Time	Chat Message / Whiteboard Activity
17	12.21.2013	1:50 PM	G_C: but correct me if I'm wrong, we are supposed to have 2 independent variables, right?
18	12.21.2013	1:50 PM	A_S: I'm suspicious about myself :)
19	12.21.2013	1:50 PM	G_C: stop_rule and mood?
20	12.21.2013	1:51 PM	A_S: yes, this is what I'm thinking
21	12.21.2013	1:52 PM	G_C: great :) then the dependent will be the number of items the participants list
22	12.21.2013	1:53 PM	A_S: because this totally depends on the mood :)
23	12.21.2013	1:53 PM	G_C: yes :)

G_C stated her satisfaction about their mutual idea and then proposed the number of items listed by participants as the dependent variable (line 21). A_S attempted to provide reasoning for this variable and interpreted that the number of items depends on the mood variable (line 22). G_C provided confirmation for the reasoning provided by A_S (line 23). Beginning from the first assignment, the team didn't experience any difficulty in identifying dependent and independent variables. This was also observed in the fifth assignment and the team correctly categorized the variables as dependent and independent.

Analysis of the messages between lines 17 and 23 in terms of the Progressive Knowledge Building Inquiry cycle results in following interpretations. In the initial message, G_C provided her solution regarding independent variables, which illustrates the *generation of idea*. Then, she asked for the confirmation in the message in line 19. A_S's agreement in line 20 to this idea is considered to be in *idea connection* phase. In the next message, G_C provided her solution regarding dependent variables, which illustrates the *idea generation*. A_S's reasoning and agreement in line 22 to this idea represents the *idea connection* phase.

Wiki Reflection

The wiki log demonstrated that all chat discussion was reflected to wiki submission of the team. That is, the team's decisions about dependent and independent variables were reported by G_C as follows: "In this experiment, the dependent variable is the number of items the participants add into their list; and the independent variables are the mood they are in and the stop_rule they follow."

Assignment-7

Dependent and Independent Variables

The session started with A_S's statement that he had experienced problem while identifying dependent and independent variables (hocam is a Turkish term used as a colloquial way to address a fellow student or colleague). Although this was the last assignment, it is the first time that the team experienced such a difficulty. Therefore, G_C offered to provide guidance to A_S (line 23). G_C suggested that there is one independent variable which is the year of students and measured in categorical scale. Additionally, she proposed the fields of psychology (statistics, experimental, social, developmental, and psychiatry, namely) as independent variables and in interval scale (line 24). A_S approved the suggestions provided by G_C (line 25). However, G_C recognized mistakes related to her offers. Therefore, she corrected the fields of psychology as dependent variables, and stated that the year as the unique independent variable (line 26). A_S responded that he had already understood the error of G_C (line 27). After this correction, G_C provided the reasoning for dependent variables by stating that the scores indicate the academic year of the student. Moreover, she explained that they can expect scores different when they compare a freshman and a junior (line 28). A_S approved the offers of G_C (line 29), which demonstrated the transfer of knowledge within the team.

Line	Date	Post Time	Chat Message / Whiteboard Activity
22	01.09.2014	2:54 PM	A_S: hocam indeed I couldn't resolve dependent and independent variables :)
23	01.09.2014	2:54 PM	G_C: may i help you with this one, at least?
24	01.09.2014	2:57 PM	G_C: hocam as far as i understood, we have only one independent variable, the year of the students, which is measured at a categorical level (ranging between 1-3). And the fields of psychology (statistics, experimental, social, developmental, and psychiatry, namely) are the independent variables, which are measured at interval level
25	01.09.2014	2:56 PM	A_S: sure hocam :)
26	01.09.2014	2:57 PM	G_C: sorry, the last ones are dependent variables, not independent variables. the only independent variable is the year. my bad :(
27	01.09.2014	2:58 PM	A_S: nope nope I understood it hocam :)
28	01.09.2014	2:59 PM	G_C: they are dependent because the scores we get indicate the academic year of the student. so we expect at least they are different when we compare a freshman and a junior
29	01.09.2014	3:03 PM	A_S: sure

In terms of Progressive Knowledge Building Inquiry cycle, some of the messages between lines 24 and 29 were detected to exist in idea generation phase. The messages in lines 24, 26, and 28 demonstrated G_C's solutions and reasonings, hence categorized in *idea generation* phase. The messages in lines 25, 27, and 29 indicated A_S's agreements to solutions.

Wiki Reflection

According to the wiki logs, G_C reported the categories variables as follows: “Independent variable: the year of the students (categorical level). Dependent var: 5 areas of psychology (statistics, social, experimental, developmental and psychiatry, namely) (interval level)” This output completely reflected the group’s decision in the chat environment, and was correct solution for the question.

NORMALITY TEST

Assignment-2

Before the chat message in line 65, A_S provided the normality test results in the whiteboard environment. Then, A_S initiated the discussion by indicating the results he presented (line 65). He individually had performed the normality analysis by using the SPSS tool and shared the outputs with group members. Similarly, G_C employed the normality test, hence offered to compare her results with the output provided by A_S (line 66). However, A_S didn’t consider the comparison, instead proposed the necessity of verbal information for the interpretation of normality test outputs (line 67). On the other hand, after checking results of the normality test, G_C faced with the confusion related to the cases. That is, G_C asked whether cases should be excluded pairwise or kept as listwise while applying the normality test (line 68). A_S agreed with the opinion of G_C to consider the cases during the normality analysis (line 69). Yet, the team provided no explicit explanation related to the procedure to be applied related to the cases. On the other hand, A_S understood the mistake in his normality results, hence decided to reapply the test and share new results in the wiki environment (line 70). After this offer, G_C stated that she would report the revised results and share them in the wiki. In addition, she expected A_S to check interpretations since she had no confidence in reading the p value (line 71). A_S agreed and stated that he would check commands of G_C after her interpretations (line 73).

Line	Date	Post Time	Chat Message / Whiteboard Activity
65	11.14.2013	2:51 PM	A_S: I paste the normality test results to the whiteboard
66	11.14.2013	2:52 PM	G_C: yes, just let me check mine
67	11.14.2013	2:53 PM	A_S: Only I miss is the text defining the result of the test with the verbals in the book :)
68	11.14.2013	3:08 PM	G_C: by the way, what do you think about excluding the cases? Should we exclude them pairwise?? or keep it listwise?
69	11.14.2013	3:10 PM	A_S: ooppsss... you're right
70	11.14.2013	3:11 PM	A_S: I made my table wrong so... Anyway, I got your point, after the chat, I will correct myself and insert the values to wiki media.
71	11.14.2013	3:13 PM	G_C: ok. i will try to report the values in the tables for the 2nd question, and then can you please check my work? I am not 100% sure (i think im having problems with reading the p value)
72	11.14.2013	3:14 PM	A_S: okey... this is better :) I check you, you check me, and Y_A will check us :)
73	11.14.2013	3:14 PM	A_S: after your writings, I will check your command on the last part of q2

The chat discussion demonstrated that the team initially experienced difficulty while performing the normality test. That is, they didn't initially consider the cases while performing the analysis. After the mutual exchange of information, they recognized this as the essential analysis step that they should not ignore. Therefore, the team could take an opportunity of revising their analysis and providing appropriate output with the help of collaborative study.

The messages between lines 65 and 70 were analyzed based on the Progressive Knowledge Building Inquiry cycle as follows. In the first three messages, members stated that they applied the normality test, which indicated the phase of *idea generation*. In the message in line 68, G_C asked about the way of excluding the cases. In the messages in line 69 and 70, A_S made a comparison about his previous solution and reached the correct solution. This demonstrated the phase of *idea connection* since there is a comparison between solutions.

Wiki Reflection

As decided during the chat discussion, A_S shared the revised normality results and G_C wrote the interpretation - "When we check the Kolmogorov-Smirnov values we have in the table, we can conclude that the volume of the brain, D(40)=0,08, p=2; Weight, D(38)=0,12, p=2; and Height, D(39)=0,12, p=,173, were normally distributed. On the other hand, IQ, D(40)=0,25, p<,001; Verbal_IQ, D(40)=0,18, p<,05, and Performance_IQ, D(40)=0,19, p<,05, were all significantly non-normal."According to the wiki output, G_C didn't face with any problem in interpreting p values and correctly examined the normality of variables.

Assignment-4

Splitting Data

Before the first chat message, Y_A shared the results of the normality test in the whiteboard area. He then indicated that he applied normality tests by using the Explore feature of SPSS, and stated that he found some variables normal and some non-normal (line 98,100,101). Through these chat messages Y_A reported his initial finding about the distribution of data, without specifically identifying normal and non-normal cases. In line 102, G_C asked whether Y_A had considered splitting the data before applying the normality test. Next, A_S commented that he obtained weird results when he tried splitting the data, and stated that he had probably done something wrong. In the next line, Y_A responded to G_C that he didn't split the file, and asked if he should had done so. G_C's response in the next line indicated that she did not consider splitting data as a necessity, but informed her teammates about a possible issue. In line 106, A_S argued that it was better to split and asked Y_A how he did the analysis without splitting (line 107). A_S stated that he shared the results in the whiteboard and asked others if they found the same results (line 108). In the following conversation, Y_A provided a summary of his steps where he explained how he conducted the normality test by using the explore menu in SPSS by defining pre-test and post-test as dependent variables (line 109, 110). As a response to the question of A_S in line 108, G_C stated that she found the same results as A_S (line 111). Previously G_C couldn't produce results, which reflected her lack of understanding in conducting the test. After the explanation of Y_A, she understood the process and reached the solution.

This short exchange among the team members indicate that they took issue with an important concern, namely identifying the correct level to check for the normality assumption. The problem statement states that there are three independent groups in the

experiment, whose scores should be tested for normality separately. Splitting the data set is one way to achieve this in SPSS depending on how the data is organized. This discussion provides evidence that the team members are aware of finding the appropriate level to apply the test, but they have neither justified nor demonstrated this explicitly.

Line	Date	Post Time	Chat Message / Whiteboard Activity
98	12.09.2013	12:00 AM	Y_A: so about the normality tests
100	12.09.2013	12:00 AM	Y_A: I've got some results from the explore menu item
101	12.09.2013	12:01 AM	Y_A: some look normal, some not.
102	12.09.2013	12:01 AM	G_C: sorry before we move on, did you split the file?
103	12.09.2013	12:01 AM	A_S: actually I splitted the file but I got weird results... I'm doing somethings wrong
104	12.09.2013	12:01 AM	Y_A: no i didn't. should I?
105	12.09.2013	12:02 AM	G_C: no, i just wanted to be sure
106	12.09.2013	12:02 AM	A_S: I think its better to split hocam
107	12.09.2013	12:03 AM	A_S: how did you do it without split Y_A?
108	12.09.2013	12:05 AM	Y_A: Check the whiteboard for my results. Did you find similar values?
109	12.09.2013	12:05 AM	Y_A: I used the explore menu.
110	12.09.2013	12:06 AM	Y_A: I put pre and post test to dependent variables, that is all.
111	12.09.2013	12:05 AM	G_C: i did

Analysis of messages between lines 100 and 111 based on Progressive Knowledge Building Inquiry cycle results in following interpretations. Initially, Y_A indicated his solution and general test results, which illustrated the *idea generation* phase. Then, the team compared their way of doing analysis and made a decision about splitting data before performing the analysis. The comparison of solutions demonstrated the phase of *idea connection*. In the messages between lines 108 and 110, Y_A explained the analysis steps he followed, which demonstrated the *idea generation* phase.

Normality Test Results

Y_A shared the SPSS output belongs to the Kolmogorov-Smirnov (K-S) and the Shapiro-Wilks (S-W) tests. Y_A interpreted that group-2 has non-normal distribution in both pre and post test scores according to the K-S test (line 112).And he continued to interpret that pre-test scores of group-1 are not normally distributed according to the S-W test (line 113). Next, the team discussed what they should do with the variables that violate normality. Y_A argued that all the scores could be considered fairly normal, since the sample size 22 was not so small and the q-q plots looked fairly on the diagonal (line 116, 117). G_C provided confirmation for the offer of Y_A (line 118). On the other hand, A_S reminded the team that when the sample size is less than 30, S-W is a more conservative test of normality, and argued that S-W could be the more reliable test in their case (line 119). By referring the content in the course slides, G_C reported that if the sample size is larger than 30, it is considered normal according to central limit theorem. Because the sample size in the question is less than 30, G_C offered to read related part in the course book (line 120).Since A_S found the S-W as the appropriate test, he shared a link of a web site that provides

detailed explanations about the S-W test (line 121). This link is actually appeared in the book but it doesn't consist of comprehensive information about the S-W test. The book's lack of information was also stated by G_C (line 122). G_C again asked the test they would consider (line 123). As a reply, A_S stated his confidence to apply S_W test since the size of participants (i.e. 22) since the data is smaller than 30 (line 124,125). Therefore, while providing the normality results, A_S recommended to consider the ones belong to the Shapiro-wilk test (line 126). In parallel to this suggestion, A_S provided an example interpretation that they can write "according to the Shapiro-wilk normality test results, Pretest Group 1 is significantly non-normal with p<0,05" (line 127,128). Moreover, he suggested Y_A to share outputs of the test results before the interpretation (line 129).

Line	Date	Post Time	Chat Message / Whiteboard Activity
112	12.09.2013	12:07 AM	Y_A: Now according to Kolmogorov-Smirnov, group 2 is always not normally distributed.
113	12.09.2013	12:07 AM	Y_A: According to Shapiro-Wilk, only group 1 in pre test is not normal.
114	12.09.2013	12:08 AM	G_C: yes
116	12.09.2013	12:09 AM	Y_A: But I think 22 values is not too little, and the tests could have a tendency to become significant because of this.
117	12.09.2013	12:10 AM	Y_A: Maybe we could look at the Q-Q plots and say the scores are fairly normal?
118	12.09.2013	12:12 AM	G_C: yes, it seems more or less normal
119	12.09.2013	12:13 AM	A_S: let me say somethings but I may be wrong... if the group size is small (<30) Shapiro Wilk is more conservative in test of normality... am I wrong?
120	12.09.2013	12:20 AM	G_C: in the lecture notes for then 3rd week, on 54th slide, it says that if N >30, it is considered normal according to central limit theorem, but we have 22; so im reading the related part from the book
121	12.09.2013	12:23 AM	A_S: If I am not wrong, the book doesn't say more in Shapiro-Wilk, they direct to companion web site... http://www.uk.sagepub.com/field4e/study/Oliver%20Twisted%20-%20CW/chapter5_olivertwisted.docx
122	12.09.2013	12:37 AM	G_C: no it doesn't
123	12.09.2013	12:38 AM	G_C: so which test are we going to report?
124	12.09.2013	12:38 AM	A_S: I'm quite sure to use Shapiro wilk
125	12.09.2013	12:39 AM	A_S: our data number is less than 30
126	12.09.2013	12:42 AM	A_S: ok to increase our speed, I recommend you to enter shapiro-wilk results:)
127	12.09.2013	12:44 AM	A_S: i.e. Pretest Group 1 is significantly significantly non-normal with p<0,05
128	12.09.2013	12:44 AM	A_S: by adding to the top of them... "According to the shapiro-wilk normality test results"
129	12.09.2013	12:44 AM	A_S: Y_A can add the screen shot of the test results

According to the Progressive Knowledge Building Inquiry cycle, the messages between lines 112 and 129 can be interpreted as follows. In the initial two messages, Y_A shared the

results of the normality test and pointed out a conflict in the results of the two normality tests reported by SPSS, which represents the *idea generation* phase. The messages in lines 116 and 117 demonstrated the *idea connection* phase, since Y_A considered the sample size and offered to analyze the results according to q-q plots. These thoughts of Y_A reflected his deep understanding while evaluating normality results. His ideas were accepted by G_C in line 118. A_S continued his search for some information he remembered seeing during the class regarding the impact of sample size on a normality test's reliability. This led him to dig down further in the text and find a web resource describing that Shapiro-Wilk's test would be more robust for smaller sample size. This can be considered as an instance of *idea improvement*, where an episode of idea generation in response to conflicting information encouraged group members to consider alternative knowledge resources. Between lines 119 and 125, the team decided on the appropriate test and provided reasoning, which illustrated the *idea connection* phase. In these messages, A_S and G_C considered the sample size as a rule of testing normality, which illustrated the surface level understanding in comparison to Y_A's thought of considering both sample size and q-q plots. In the message 127, A_S provided the interpretation, which is considered in *idea generation* phase.

Outliers

In the following part of the discussion, Y_A proposed that the deviation from normality was originated from existence of an outlier. He actually noticed the outlier on the q-q plot, and wondered that if it could be a typo in the data (line 130, 131). G_C agreed on the presence of an outlier but considered it a genuine data point, since no information about minimum and maximum possible scores were given in the problem statement (line 133). Then, the team agreed that the outlier was not treated to be like a typo (line 135). A_S expected to learn if they would ignore the outlier and consider pre-test scores of group-1 as normal (line 132). Y_A proposed to explain the significance of the S-W test due to the presence of this outlier score, and apply a parametric test for subsequent analysis (line 136). G_C and A_S's agreement concluded the discussion related to the inspection of the assumption of normality.

Line	Date	Post Time	Chat Message / Whiteboard Activity
130	12.09.2013	12:46 AM	Y_A: if we look at the Q-Q plot for the pre test group 1, the non-normalness is because of an outlier.
131	12.09.2013	12:46 AM	Y_A: The subject who got 13.
132	12.09.2013	12:49 AM	A_S: yeap... so you say if we dismiss that outlier, the data is normal... which kolmogorov test says is correct?
133	12.09.2013	12:49 AM	G_C: i realized it but then since the instructor didn't mention any lower or upper score value, i took it as it is an actual score but not a typo. my mistake.
134	12.09.2013	12:50 AM	G_C: then we are going to do it exclude cases pairwise?
135	12.09.2013	12:52 AM	Y_A: i don't think it's a typo either. by outlier i meant a value unlike the others.
136	12.09.2013	12:53 AM	Y_A: i think we can say the significance of the Shapiro-Wilk test is due to this one subject, and we can keep on with the analysis.
137	12.09.2013	12:53 AM	G_C: ok

The analysis of messages between lines 130 and 137 based on Progressive Knowledge Building Inquiry cycle has the following interpretations. In the initial message, Y_A indicated the reason of non-normal case as the outlier, which indicates the *idea connection* since there is a comparison between normal and non-normal cases and final reasoning. In the message in line in 132, A_S offered to ignore the outlier to satisfy normality. Since there is a further reasoning about the outlier, it represents the phase of *idea improvement*. In the message in line 133, G_C stated her initial and final understanding of the outlier, which represents a comparison between ideas, hence considered in *idea connection* phase. In the next message, Y_A provided ideas about the definition of the outlier which represent the *idea generation*. In the message in line 136, Y_A offered the way of interpreting normality results, which demonstrates a further reasoning, hence *idea improvement* stage. In the final message, G_C accepted the idea.

Wiki Reflection

Y_A provided the results of the normality tests through a table, and G_C contributed to the corresponding interpretation as follows: "By looking at the tests of normality table, we can say that for pre-test only the 1st group is significantly different (D(22)=,91, p<,05) from a normal distribution. However, for the post test condition, all the groups are normally distributed (p>,05)".

The wiki summary does not capture all the details of the team's chat discussion. They presented the normality analysis with the correct groupings, but provided the standard interpretation of the K-S test results. The wiki posting for this particular question seem to suggest that the group members changed their mind about treating the pre-test score of group-1 as normally distributed. In particular, they didn't mention their noticing about the outlier and its effect on the normality test. However, in the remaining parts of the question, the team employed a parametric test to complete their analysis, which seemed to be a consequence of this discussion.

Assignment-5

G_C initiated the discussion by offering to perform the question, which expects checking data set according to the parametric assumptions of ANOVA (line 74). A_S had lack of information about the required assumptions, hence asked if they should apply levene's or normality test (line 75). G_C responded that they should consider both tests (line 76). After identifying the necessary assumptions, A_S recommended that each member could do analysis individually and then they could compare the results (line 78). G_C accepted this offer (line 79). Although A_S could perform the normality test (line 80), G_C stated her problem of obtaining meaningful results (line 81). Therefore, A_S decided to explain steps of analysis in order to progress in parallel way (line 82). This demonstrated that knowledgeable members share their experiences with other members in the group.

Line	Date	Post Time	Chat Message / Whiteboard Activity
74	12.21.2013	3:10 PM	G_C: now, shall we move on to c?
75	12.21.2013	3:11 PM	A_S: yes:) is levene's test enough for this part? or we should add normality tests?
76	12.21.2013	3:12 PM	G_C: we have to do both
77	12.21.2013	3:14 PM	A_S: okey
78	12.21.2013	3:14 PM	A_S: lets do it separately and compare our results :)
79	12.21.2013	3:15 PM	G_C: ok
80	12.21.2013	3:47 PM	A_S: I think I have finished:) but only the normality test :)
81	12.21.2013	3:56 PM	G_C: i think my results are wrong :(can you also handle the levene's test?? because i don't get the same results
82	12.21.2013	3:57 PM	A_S: let me tell you the steps in the phone... its better to move in coherence I think
83	12.21.2013	3:57 PM	A_S: according to kolmogorov-smirnov test of normality, in all moods (positive, negative and neutral) the number of items they add into their list in each rule is normally distributed p>0,05
84	12.21.2013	4:30 PM	A_S: I think I've finished editing part c :)
85	12.21.2013	4:32 PM	A_S: what about our wordings? This data set satisfies the parametric assumptions of anova
86	12.21.2013	4:36 PM	A_S: according to kolmogorov-smirnov test of normality, in all moods (positive, negative and neutral) the number of items they add into their list in each rule is normally distributed p>0,05
87	12.21.2013	4:37 PM	G_C: yes, i guess this indicates a normally distributed scores, right?
88	12.21.2013	4:37 PM	A_S: I think so

A_S preferred to share the normality results in the whiteboard area and interpreted that "according to kolmogorov-smirnov test of normality, in all moods (positive, negative and neutral) the number of items they add into their list in each rule is normally distributed p>0,05" (line 83).Since he had knowledge about the required steps of the normality analysis, he could obtain the results and interpreted them appropriately. After providing the normality results, A_S considered to provide more general interpretation and offered to indicate that the data set satisfies the parametric assumptions of anova (line 85). Since A_S couldn't receive any feedback from the other team members, he repeated the interpretation of the normality test (line 86). This time, G_C confirmed that the results indicated normally distributed scores (line 87) and A_S accepted this interpretation (line 88).

Analysis of messages between lines 74 and 88 in terms of Progressive Knowledge Building Inquiry cycle leads to following interpretations. In the initial message, G_C offered to study on question c, which is a trigger activity that expects to obtain ideas of members for the solution of the question. In the messages in line 75 and in line 76, members suggested to apply levene and normality tests as the solution, which are considered in *idea generation* stage. G_C faced with difficulty in applying the tests. Therefore, A_S explained the steps of

analysis. In the messages between lines 83 and 86, A_S explained his solution and results of the tests, which represent the *idea generation* stage. In the message in line 87, G_C indicated the interpretation based on results, which demonstrated the *idea connection* phase.

Wiki Reflection

As the team discussed in the chat environment, A_S shared the normality results and wrote the interpretations as follows: "This data set satisfies the parametric assumptions of ANOVA. According to Kolmogorov-Smirnov test of normality, in all moods (positive, negative and neutral) the number of items they add into their list in each rule is normally distributed p>0,05."

Assignment-6

G_C indicated the necessity of normality test to check whether scores are normally distributed or not (line 61). Since A_S had probably applied some tests by using the SPSS tool, he checked outputs but couldn't find results related to the normality test. Therefore, A_S suggested that each member can do analysis individually and then they can compare their results (line 64). G_C presented her findings that condition 1 has normal distribution with the p value 0,010.In addition, she found p values 0,149 and 0,200 for conditions 2 and 3 correspondingly. A_S agreed and interpreted that "Condition 1 of this data set is normal with p<0,05, whereas Condition 2 & 3 are non-normal with p>0,05" in the following lines.

Line	Date	Post Time	Chat Message / Whiteboard Activity
61	12.28.2013	2:27 PM	G_C: we need to run a normality test, see if the scores are normally distributed or not, and also we need to look for sphericity
62	12.28.2013	2:28 PM	A_S: okey then... let me check if we had normality results in the SPSS output
63	12.28.2013	2:28 PM	G_C: ok
64	12.28.2013	2:30 PM	A_S: Mmm... I think we didn't :) lets run it and compare our results
65	12.28.2013	2:30 PM	G_C: ok
66	12.28.2013	2:33 PM	G_C: what i have is only condition 1 (no audit) is normally distributed (p=,010). p for condition 2 is 0149; and p for 3 is ,200
67	12.28.2013	2:33 PM	G_C: is it the same?
68	12.28.2013	2:34 PM	A_S: they are the same

The initial interpretations of the team revealed that G_C could not correctly interpret the p values. On the other hand, A_S had no warning and provided the same interpretation as her.

The messages from line 61 to 68 were analyzed according to the Progressive Knowledge Building Inquiry cycle, and following results were obtained. In the first message, G_C offered to apply the normality test, which represents the *idea generation*. In the next four messages, the team decided to apply and then compare the results. The message in line 66 demonstrates the *idea generation* since G_C provided the normality results and corresponding interpretation. The message in line 68 is considered as *idea connection*, since A_S indicated the result of comparison related to the normality test results.

Wiki Reflection

The wiki output consists of completely different content in comparison to chat discussion of the team. That is, A_S shared the revised results of the normality test as follows: "According to Shapiro-Wilk Test of Normality (since the sample size is small) Condition 1, Condition 2 & Condition 3 are significantly normal with D(18) = 0.899; D(18) = 0.897 and D(18) = 0.949 respectively with p>0.05." We can understand that the group conducted the analysis again and corrected the results and interpretation of the normality test.

Assignment-7

Line	Date	Post Time	Chat Message / Whiteboard Activity
60	01.09.2014	3:25 PM	G_C: firstly, we do normality using good old explore :)
61	01.09.2014	3:26 PM	A_S: ahaha ok lets start with it first:)
62	01.09.2014	3:30 PM	G_C: :) yes. i only have a significant value for the developmental-2nd year students.
63	01.09.2014	3:32 PM	A_S: didn't you include others to the dependent list hocam? :)
64	01.09.2014	3:32 PM	A_S: I mean the three courses
65	01.09.2014	3:32 PM	G_C: i did, but they are all >,05
66	01.09.2014	3:33 PM	A_S: ahaha ok :) I confused it :9
67	01.09.2014	3:33 PM	A_S: btw... you used Shapiro wilk?
68	01.09.2014	3:35 PM	G_C: no, Kolmogorov-smirnov
69	01.09.2014	3:37 PM	A_S: hmm... I got experimental psychology,
70	01.09.2014	3:37 PM	A_S: social psychology and development as normal
71	01.09.2014	3:38 PM	A_S: oopppsss... I didn't split my file :(
72	01.09.2014	3:38 PM	G_C: neither did I
73	01.09.2014	3:40 PM	G_C: I'm not sure but maybe we can look for s-w. you may be right because Kolmogorov-smirnovis leading us to nowhere
74	01.09.2014	3:42 PM	A_S: it leads us no where
75	01.09.2014	3:42 PM	A_S: and the sample sizes are low
76	01.09.2014	3:43 PM	A_S: and Shapiro wilk results are all p>0.05 :) a
77	01.09.2014	3:44 PM	G_C: :) of of :(
78	01.09.2014	3:25 PM	G_C: ,i have a wonderful suggestion: lets leave it there, and discuss it tomorrow :)

In order to check the assumptions, G_C recommended conducting the normality test (line 60) and A_S agreed with this idea (line 61). According to the results of the normality test, G_C found that only significance value belongs to the developmental-2nd year students (line 62). A_S asked if G_C included three courses in the dependent list (line 63, 64). As a reply, G_C stated that she considered the courses as dependent and found p value for all courses larger than 0,05(line 65). A_S understood the result and then asked whether G_C considered results of Shapiro-wilk for normality (line 66,67). G_C responded that she applied Kolmogorov-smirnov test (line 68). A_S recognized that his results were different from the

ones that G_C shared (line 69, 70). After reviewing his steps, A_S thought that the reason for the difference that he didn't split the file before the analysis (line 71). However, G_C stated that she also didn't split the file (line 72). G_C indicated her confusion and stated that they may consider the results of Shapiro-wilk since the Kolmogorov-smirnov results do not lead the team to acquire expected results (line 73). A_S accepted the idea of considering results of Shapiro-wilk since the sample size is low. According to the results of Shapiro-wilk, A_S found all the results normal (line 74,75,76). Yet, G_C experienced confusion while deciding on the appropriate test (line 77), therefore suggested continuing later on (line 78).

The analysis of messages between lines 60 and 78 based on Progressive Knowledge Building Inquiry cycle has the following interpretations. In these messages, members generated ideas for the application of normality test. However, they couldn't reach an appropriate solution, which was seen in the last message – they decided to leave the discussion and study later on.

Wiki Reflection

The team did not share results of normality in the wiki environment. During the chat discussion, it was observed that the team faced with problem while interpreting the results of normality test. Since, the team didn't provide any wiki output, one can interpret that the team couldn't come to a decision in identifying the appropriate normality test they should consider.

STATISTICAL TESTS

ASSIGNMENT-2 Applying and Interpreting Correlation

The assignment includes following statement for the third question:

Produce a correlation matrix including entries for IQ, Verbal_IQ, Performance_IQ, MRI_Volume, height and weight.

a. Describe the relationship among these variables in terms of the correlation coefficients you have computed. How much of the variability is shared by each pair of variables?

b.What is the correlation between MRI_Volume and Verbal_IQ when the effect of Performance_IQ on both variables are controlled? Try to interpret the pattern of covariation among MRI_Volume and Verbal_IQ by comparing the regular and partial correlation values (i.e. what do these results tell you about the relationship between MRI_Volume and Verbal_IQ)?

Stating to apply bivariate and partial correlation for questions 3a and 3b respectively

A_S asked the team if any member performed analysis for the solution of third question. G_C indicated that she created tables for questions 3a (bivariate) and 3b (partial correlation). On the other hand, A_S didn't have knowledge about the appropriate test, hence asked if she applied ANOVA. As a response, G_C stated that she applied bivariate and partial correlation.

Line	Date	Post Time	Chat Message
77	11/14/2013	3:15 PM	A_S: Did you have a chance to do somethings on Q3 yesterday?
78	11/14/2013	3:16 PM	A_S: Let me take a cup of coffee :) I'm will be here in a couple of minutes :)
79	11/14/2013	3:16 PM	G_C: well personally i did something;
80	11/14/2013	3:18 PM	G_C: i created the tables for the 3a (bivariate) and 3b (partial correlation)
81	11/14/2013	3:17 PM	A_S: Actually I didn't do anything on q3 and q4 :(
82	11/14/2013	3:18 PM	G_C: i also tried to read them, but guess what, i am not sure if i am correct :)
83	11/14/2013	3:20 PM	A_S: You did ANOVA?
84	11/14/2013	3:21 PM	G_C: no, analyze --> correlate ---> bivariate and partial correlation

Messages between lines 77 and 84 can be analyzed according to the Progressive Knowledge Building Inquiry cycle as follows. The message in line 77 is a trigger activity that attempts to obtain solutions of members for the third question. As a response, G_C indicated that she created tables for the 3a (bivariate) and 3b (partial correlation) in line 80, which demonstrates the *idea generation* phase. A_S stated that he didn't perform any analysis for the question in line 81 and asked if G_C applied ANOVA in line 83. G_C disagreed with the application of ANOVA and offered the steps of correlation in line 84, which can be considered in both *idea connection* and *idea generation* phase.

Misunderstanding and explanation about r square

G_C shared the correlation results by e-mail and indicated the first table as the correlation table. After reviewing the table, A_S recognized that it covers sum of squares and cross products, hence asked if there is necessity for mentioning them (line 124-125). G_C responded that they need sum of squares since they refer r square (line 127).However, this was not a correct understanding. That is, sum of squares and r squares correspond to different concepts.

Regarding r square, A_S didn't agree with G_C and explained its meaning as the square of pearson correlation value (line 131-132). In addition, A_S provided an example that shows correlation, r square and shared variability between two variables - weight and MRI_Volume (line 133-137).

Line	Date	Post Time	Chat Message
120	11/16/2013	11:31 AM	G_C: let me check the output file first, ok?
121	11/16/2013	11:31 AM	A_S: yes, I meant we don't need to look for all correlation test, am I wrong?
122	11/16/2013	11:31 AM	G_C:no, that's ok :)
123	11/16/2013	11:35 AM	G_C: no, i think the very first table i sent was the correlation table;
124	11/16/2013	11:37 AM	A_S: sorry yes... but anyway it includes sum of squares and cross products also
125	11/16/2013	11:37 AM	A_S: do we need to mention them?
126	11/16/2013	11:37 AM	A_S: Also another point... from page... wait please
127	11/16/2013	11:40 AM	G_C: we need the sum of squares for 3a, i think. They are what the teacher called r square, right?
128	11/16/2013	11:39 AM	A_S: page 176... we need to make two tailed test since we don't know the relation of the variables
129	11/16/2013	11:39 AM	A_S: I mean we can't say that we are sure that as the height of the person increase, the intelligence increased
130	11/16/2013	11:40 AM	G_C: ok
131	11/16/2013	11:40 AM	A_S: nope unfortunately
132	11/16/2013	11:41 AM	A_S: r square is the value that we have to square namely Pearson correlation value
133	11/16/2013	11:41 AM	A_S: for example...
134	11/16/2013	11:42 AM	A_S: weight and MRI_Volume pearson correlation is 0,513
135	11/16/2013	11:42 AM	A_S: R^2 (R square) is the square of this value... let me calculate with calculator :)
136	11/16/2013	11:43 AM	A_S: 0,263169
137	11/16/2013	11:46 AM	A_S: This means that weight shares 26,1% of the variability in MRI_Volume
138	11/16/2013	11:47 AM	A_S: I think we should answer them in part q
139	11/16/2013	11:48 AM	A_S: vise versa is valid here since the correlation matrix is symmetric

In terms of the Progressive Knowledge Building Inquiry cycle, following interpretations can be done for the messages between lines 120 and 139. A_S and G_C generated ideas about the appropriate test (correlation, two tailed) and values (r square) between lines 120 and 130. In the message in line 127, G_C experienced confusion that sum of squares refers r square. A_S provided the correct definition of r square in line 132 and provided example calculations between lines 133 and 139, which can be considered in *idea improvement* phase since there are further explanations and examples.

Understanding Coefficient of Determination

A_S offered to apply partial correlation for the question b (line 143) and G_C provided confirmation to the idea of A_S (line 144).

As the statement of the question 3a, G_C indicated that it asks how much variability is shared by each pair of variables (line 148). A_S had the same idea as G_C (line 149). In

addition, G_C suggested mentioning coefficient of determination in the same question (line 153). Yet, A_S didn't have knowledge about the coefficient of determination (line 155). In order to satisfy his understanding, G_C offered to consider the statement provided by the instructor that R^2=1-SSres (sum of squares residuals)/SStotal (Total variability in the data) (line 156). A_S stated that this can be correct explanation. But, with the simple explanation, A_S stated that it is square of pearsons correlation coefficient provided in the spss results (line 159). G_C reviewed the lecture notes and achieved the understanding.

Line	Date	Post Time	Chat Message
143	11/16/2013	11:51 AM	A_S: in part b we should do partial correlation, am i wrong?
144	11/16/2013	11:52 AM	G_C: yes, i think for parts b and c, we should run a partial correlation.
145	11/16/2013	11:52 AM	A_S: also in c
146	11/16/2013	11:52 AM	G_C: yes :)
147	11/16/2013	11:52 AM	A_S: :) hurray we are thinking the same :)
148	11/16/2013	11:53 AM	G_C: for 3a, it asks how much of the variability, is shared by each pair of variables?
149	11/16/2013	11:53 AM	A_S: yes and we should write them lots of times :(
150	11/16/2013	11:53 AM	:)
151	11/16/2013	11:54 AM	A_S: approximately 65463543654654 times :)
152	11/16/2013	11:54 AM	:)
153	11/16/2013	11:55 AM	G_C: there we should mention coefficient of determination.
154	11/16/2013	11:55 AM	A_S: ok if I'M not wrong 14 times :)
155	11/16/2013	11:56 AM	A_S: coefficient of determination?
156	11/16/2013	11:57 AM	G_C: yes, the instructor said that R^2=1-SSres (sum of squares residuals)/SStotal (Total variability in the data)
157	11/16/2013	11:57 AM	G_C: I have seen this in the slides, too
158	11/16/2013	11:57 AM	G_C: just let me find where i did
159	11/16/2013	11:58 AM	A_S: yes this can be true :) but we simply square pearsons correlation coefficient that spss gives us
160	11/16/2013	11:58 AM	G_C: ok, i saw it in the lecture notes of linear regression
161	11/16/2013	11:59 AM	G_C: ok, i just got the note, i was thinking, how will i ever figure it out :)
162	11/16/2013	11:59 AM	G_C: thanks :)
163	11/16/2013	12:01 PM	A_S: your welcome :)

Analysis of messages between lines 143 and 163 can be conducted according to the Progressive Knowledge Building Inquiry cycle as follows. Between lines 143 and 153, members *generated ideas* about the appropriate tests for the part a, b and c. A_S asked the meaning of coefficient of determination in line 155. Members generated ideas: G_C indicated its calculation as R^2=1-SSres (sum of squares residuals)/SStotal (Total variability in the data) in line 156 and A_S stated its calculation basically as the square of pearsons correlation coefficient in line 159. G_C compared the calculations based on lecture notes and

agreed with the idea of A_S in lines 160, 161, which are considered in *idea connection* phase.

Misunderstanding and Interpretation of Correlation Results

G_C provided wrong interpretation about the results of the correlation when it is equal to +1. For her understanding, if the correlation is +1, then there is a positive relationship between two variables (line 165). A_S indicated the wrongness and provided the correct interpretation that "if it is 1 this means that it is fully correlated (i.e weight correlated with weight)" (line 170). In addition, A_S explained the positive correlation (line 171) by explaining the mutual increase in two variables.

G_C interpreted correlation results that there are positive correlations between IQ and other variables apart from the correlation between IQ, and height and the correlation between IQ, and weight (line 167). A_S provided confirmation (line 176) and stated that the correlation between IQ, and height and the correlation between IQ, and weight are not significant (line 179).

Line	Date	Post Time	Chat Message
165	11/16/2013	12:05 PM	G_C: ok so in the book it says that if the correlation is +1, then there is a positive relationship between 2 variables (pg 170)
166	11/16/2013	12:06 PM	A_S: :) we should do two tailed and no other options like crossproducts etc
167	11/16/2013	12:06 PM	G_C: so i think we can say that apart from height and weight, there are positive correlations between IQ and other variables.
168	11/16/2013	12:07 PM	A_S: no exactly
169	11/16/2013	12:07 PM	G_C: yes, thank you for letting me know. i totally missed that part
170	11/16/2013	12:07 PM	A_S: if it is 1 this means that it is fully correlated (i.e weight correlated with weight)
171	11/16/2013	12:08 PM	A_S: if the correlation is positive, we say that if aksdhak increases then dskdjf increases
172	11/16/2013	12:08 PM	G_C: no no,) i only said Iqvs other variables (just read the first row) :)
173	11/16/2013	12:08 PM	A_S: and if it is negative, this command changes :P
174	11/16/2013	12:08 PM	G_C: yes, i know
175	11/16/2013	12:09 PM	A_S: ooppsss ok wait :)
176	11/16/2013	12:10 PM	A_S: yes you are totally right :) apart from height and weight
177	11/16/2013	12:11 PM	A_S: but.... :)
178	11/16/2013	12:11 PM	A_S: the significance of height and weight are greater than 0,05
179	11/16/2013	12:12 PM	A_S: this means there is no significant correlation between IQ and weight and height :P

Analysis of messages between lines 165 and 179 based on Progressive Knowledge Building Inquiry cycle results in following interpretations. In lines 165 and 167, G_C made interpretations about correlation results, which are considered in *idea generation* phase. In line 168, A_S indicated the wrongness of her interpretations, which demonstrates the *idea*

connection phase since there is a comparison. A_S explained the interpretation of positive correlation in lines 170 and 171, which is the *idea generation*. In the line 172, G_C made a clarification regarding her interpretation, hence between lines 176 and 179, A_S provided agreement and explanations which can be considered both in *idea generation* and *idea connection* phase.

Wiki Reflection

For question a, the team could correctly provided the variability shared by each pair of variables as follows:

"R2 is calculated by squaring the Pearson Correlation Coefficients in the table. Giving this value as percentage lets us give the amount of sharing.

- Verbal_IQ shares 89.9% (0.947x0.947) of the variability in IQ.
- Performance_IQ shares 87.2% of the variability in IQ.
- MRI_Volume shares 12.8% of the variability in IQ.
- Height shares 0.74% of the variability in IQ.
- Weight shares 0.26% of the variability in IQ.
- Performance_IQ shares 60.5% of the variability in Verbal_IQ.
- MRI_Volume shares 11.4% of the variability in Verbal_IQ.
- Height shares 0.5% of the variability in Verbal_IQ.
- Weight shares 0.57% of the variability in Verbal_IQ.
- MRI_Volume shares 15% of the variability in Performance_IQ.
- Height shares 0.6% of the variability in Performance_IQ.
- Weight shares 0.0009% of the variability in Performance_IQ.
- Height shares 36.24% of the variability in MRI_Volume.
- Weight shares 26.3% of the variability in MRI_Volume.
- Weight shares 49% of the variability in Height"

For question b, the team correctly provided the correlation between MRI_Volume and Verbal_IQ when the effect of Performance_IQ on both variables are controlled as follows:

"There is a positive correlation between the Verbal Iq and MRI_Volume (r=,34, p>,05); Performance IQ and MRI Volume (r=,39, p>,05). Additionally, Verbal IQ and Performance IQ are significantly correlated (r=,78, p<,05). These all explain that as one variable value increases, so does the other in each pair."

ASSIGNMENT-4 Applying and Interpreting Anova

The assignment includes following statement for the third question:

A study of reading comprehension in children compared three methods of instruction. First, all participants' reading comprehension levels were assessed with a pre-test. Then, participants were split into 3 groups, where they were exposed different methods of instruction to develop their reading comprehension skills. Finally, all group members were given a post-test that is comparable to the pre-test in terms of content. The data for the study is stored in reading.sav file.

3. Focus on the pre-test results only. Draw a bar chart with 95% confidence intervals. Is there a difference among the groups? Which test would be appropriate to test whether there is a statistically significant difference among the groups and why? What is the null hypothesis? Do the test and report the test results (you should use the reporting guidelines in the book). If there is an overall difference, which pair of groups differ from each other? Again, explain what statistical test you are using to make that argument.

Interpreting Bar chart

The team started to work on third question. A_S interpreted that there is no difference between groups according to the bar chart (line 240). After reviewing the chart, G_C provided confirmation to the equality between groups (line 241).

Applying Anova and Interpreting Results

A_S indicated that they should use Anova in order to avoid familywise error and reveal difference among three groups (line 243). G_C provided confirmation to the idea of A_S (line 244).

Line	Date	Post Time	Chat Message
239	12/11/2013	12:44 AM	A_S: so lets start from 3rd question hocam ok?
240	12/11/2013	12:44 AM	A_S: according to bar chart there is no difference between groups... am i wrong?
241	12/11/2013	12:45 AM	G_C: they seem quite equal more or less, so I'll agree with you
242	12/11/2013	12:45 AM	A_S: so then lets you edit the page again hocam :)
243	12/11/2013	12:47 AM	A_S: and we should note that we will use ANOVA to avoid familywise error, since we have 3 groups
244	12/11/2013	12:48 AM	G_C: ok, hocam you had the table saying the significance value of
245	12/11/2013	12:48 AM	G_C: ,895
246	12/11/2013	12:49 AM	G_C: so can we say that since p>,05, we cannot reject the null hypo?
247	12/11/2013	12:49 AM	A_S: let me check it again hocam
248	12/11/2013	12:50 AM	A_S: yesss :)
249	12/11/2013	12:50 AM	A_S: I am with you
251	12/11/2013	12:51 AM	G_C: well then, I'm on the right way :)
252	12/11/2013	12:52 AM	G_C: When the null hypothesis is accepted, observing an F value of ,111 is very likely (p>,05), so we can not reject the null hypothesis.
253	12/11/2013	12:52 AM	G_C: shall i write this way?
254	12/11/2013	12:52 AM	A_S: super :)
255	12/11/2013	12:53 AM	G_C: ok than. Thanks hocam :)
256	12/11/2013	12:53 AM	A_S: your welcome hocam

G_C obtained the anova results and indicated the significance value as ,895. Therefore, G_C suggested not rejecting the null hypo (line 246). After checking the results, A_S presented the same idea (line 249).

Regarding the F value, G_C stated that "when the null hypothesis is accepted, observing an F value of ,111 is very likely (p>,05), so we can not reject the null hypothesis." (line 252). A_S presented the same idea as G_C.

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 239 and 256 can be analyzed as follows. The initial message is categorized as trigger activity that expects solutions of members for the 3rd question. In the remaining messages, learners generated ideas and made a comparison about their solutions, hence considered in *idea generation* and i*dea connection* phases.

Wiki Reflection

As the team discussed in the chat environment, they shared the anova results and wrote the interpretations as follows: "To see if there is a difference between the groups and to avoid family wise error (since we have three groups), we had to run ANOVA test. When the null hypothesis is accepted, observing an F value of ,111 is very likely (p>,05), so we can not reject the null hypothesis."

ASSIGNMENT-6

The assignment includes following statement:

A researcher who is interested in the effects of rhythmic auditory intervention on sensory-motor coordination administers an experiment where subjects are asked to complete the rotary pursuit task. In this task the goal is to pursue the rotating circle with the mouse cursor. 18 randomly selected participants perform the task under three conditions. In condition 1 there is no auditory stimulation. In the other two conditions the subject hears a periodic clicking sound. In condition 2, the click occurs twice per second, whereas in condition 3 the click occurs six times per second. In all conditions the circle rotates at the same speed (1 rotation per second) in the clockwise direction. The experimenter counterbalanced the order of the conditions. The following data is collected:
Subject 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Condition 1 35 32 33 32 31 29 29 27 27 28 27 27 24 24 17 17 14 13
Condition 2 39 35 32 32 33 30 31 29 31 27 27 26 29 25 16 15 15 13
Condition 3 32 31 28 29 26 29 27 27 24 24 23 23 19 19 18 17 12 13

d. In the description we are told that the experimenter counterbalanced the order of the conditions. What does this mean? Why is it important? How many different orders are possible in this experiment? If you were the experimenter how would you do the counterbalancing?

COUNTERBALANCING

Understanding Counterbalancing (line18-33)

The team had firstly no understanding about counterbalancing. After the web search, A_S shared related links and explanations related to the counterbalancing. He then defined the counterbalancing as the possible orders of conditions to control order effects. In this way, they came to understanding.

Deciding on Order

Line	Date	Post Time	Chat Message
18	12/28/2013	9:29 AM	A_S: sure :) by the way... I was just to ask you if you have an idea on what counterbalancing is but....
19	12/28/2013	9:29 AM	A_S: Instructor asked it :D
20	12/28/2013	9:31 AM	G_C: well, i have that question in mind. i tried to check the lecture slides, however, i couldn't find ANY pptx or pdf files for ANY week. i think there is a problem?
21	12/28/2013	9:31 AM	G_C: i emailed the instructor about it but he hasn't emailed back yet
22	12/28/2013	9:33 AM	A_S: let me try the experiment in the link provided... May be we have an appropriate answer
23	12/28/2013	9:33 AM	G_C: ok hocam
27	12/28/2013	10:50 AM	A_S: let's start like that :)
28	12/28/2013	10:50 AM	A_S: Counterbalancing is usually thought of as a method for controlling order effects in a repeated measures design
29	12/28/2013	10:50 AM	A_S: http://www.unc.edu/courses/2008spring/psyc/270/001/counterbalancing.html
30	12/28/2013	10:50 AM	A_S: or use only http://www.psychwiki.com/wiki/Counterbalancing
31	12/28/2013	10:51 AM	A_S: Counterbalancing can be defined as using all of the possible orders of conditions to control order effects
32	12/28/2013	10:51 AM	A_S: I think second link is better and fits more to our situation
33	12/28/2013	10:52 AM	G_C: yes hocam, i was just thinking the same thing
34	12/28/2013	10:54 AM	A_S: okey, so which counterbalancing do you recommend hocam?
35	12/28/2013	10:54 AM	A_S: there are 3!=3x2x1=6 different orders
36	12/28/2013	10:56 AM	G_C: yes; well if i got it correctly, i would do it like firstly, i would do the no audit stimuli condition, then 2 and finally 6. there would be an incremental fashion of stimuli exposing to the participants.
37	12/28/2013	10:57 AM	G_C: what do you think? in other words, i would do the same : condition 1, 2 and 3
38	12/28/2013	10:57 AM	A_S: This is exactly what I think
39	12/28/2013	10:57 AM	A_S: but I think we should give some other options... so as to counterbalance
40	12/28/2013	10:58 AM	G_C: yes, then the other options would be the reverse order : 6 - 2 - 0 (or namely, condition 3 - 2 - 1)
41	12/28/2013	10:59 AM	G_C: but i think any other ordering would not be that good. am i wrong?
42	12/28/2013	11:00 AM	A_S: 2-1-3 could also give a metric for the experimenter may be

A_S stated there are totally 6 different orders and asked the counterbalancing they should apply. G_C proposed that they can use the 0-2-6 order since there would be an incremental fashion of stimuli exposing to the participants. A_S provided confirmation to this idea, but offered to consider other orders to counterbalance. According to his idea, 2-1-3 can be the possible order.
The messages between lines 18 and 23 demonstrated the learners' talk about the source they searched for understanding counterbalancing. The messages between lines 28 and 42 can be analyzed according to the Progressive Knowledge Building Inquiry cycle as follows. In the messages between lines 28 and 31, A_S provided definition and web sources for the counterbalancing, which demonstrated the *idea generation* phase. In the message in line 32, he decided to employ the definition in the second source, which reflects a comparison and considered in *idea connection phase*. In the message in line 33, G_C provided agreement to the idea. In the messages between lines 34 and 42, members generated ideas for the possible orders to satisfy counterbalancing.

Deciding on order

A_S expected to understand if they should use of all possible orders of conditions for counterbalancing. G_C replied that they can use the same order as experimenter or the 2-1-3 order. On the other hand, she wasn't sure enough about this offer. Yet, A_S provided confirmation to the solution of G_C.

Line	Date	Post Time	Chat Message
47	12/28/2013	11:01 AM	A_S: Counterbalancing can be defined as using all of the possible orders of conditions to control order effects
48	12/28/2013	11:01 AM	A_S: should we use all different conditions?
49	12/28/2013	11:02 AM	G_C: no i don't think so.
50	12/28/2013	11:03 AM	G_C: i think if say something like: "we would do the same ordering with the experimenter, or maybe having a 2 1 3 ordering may also have significant results", that would be enough? or am i oversimplifying the picture?
51	12/28/2013	11:07 AM	A_S: I think I'm neutral :) but to simplify, yours is better

The messages between lines 47 and 51 can be analyzed according to the Progressive Knowledge Building Inquiry cycle as follows. In the message in line 47, A_S *generated an idea* about the definition of counterbalancing and in line 48 he asked a question about the use of all conditions. G_C indicated disagreement in line 49 and in the 50th message, G_C provided her idea regarding the order they should employ, which was considered in *idea generation* phase. This was accepted by A_S in the last message, which was considered in *idea connection* phase.

Updating order of conditions

In this session Y_A involved in the discussion and informed the team that there are other combinations for the order of conditions. Accordingly, he stated that they should use all the combinations, which are 1-2-3, 1-3-2, 2-3-1, 2-1-3, 3-1-2, 3-2-1. Other members gained understanding and updated the conditions as suggested by Y_A.

Line	Date	Post Time	Chat Message
86	12/28/2013	2:50 PM	Y_A: Towards the end, you have written "Condition (1-2-3) Condition (3-2-1) Condition (2-1-3)". But maybe we should write the other combinations too.
87	12/28/2013	2:50 PM	A_S: ooppsss.. yes hocam
88	12/28/2013	2:50 PM	Y_A: There are six combinations in total. There are 18 subjects, so each combination would be performed by two subjects.
89	12/28/2013	2:50 PM	A_S: ahaha G_C... this is where we stuck :)
90	12/28/2013	2:50 PM	G_C: exactly
91	12/28/2013	2:51 PM	Y_A: 1-2-3, 1-3-2, 2-3-1, 2-1-3, 3-1-2, 3-2-1.
92	12/28/2013	2:52 PM	A_S: even 3 subjects Y_A :) 18/6=3 :)
93	12/28/2013	2:52 PM	Y_A: ?!
94	12/28/2013	2:52 PM	Y_A: How did I get that wrong? :)
95	12/28/2013	2:53 PM	Y_A: Now I'm looking at part e as well.
96	12/28/2013	2:53 PM	A_S: :) hocam we stuck on that point while we were editing
97	12/28/2013	2:54 PM	A_S: so hocam... let me add those conditions... okey?
98	12/28/2013	3:00 PM	Y_A: ok

Analysis of messages between lines 86 and 98 based on the Progressive Knowledge Building Inquiry cycle results in following interpretations. In lines 86, 88, and 91, Y_A provided the combinations they should consider for the counterbalancing, which demonstrated the *idea generation* phase. In the messages in lines 87, 89, 90, other members accepted his idea and updated the conditions as suggested by Y_A.

Wiki Reflection

In the chat environment, they offered two different web sites to get definition of counterbalancing. In the wiki content, they explained that they got help from http://www.psychwiki.com/wiki/Counterbalancing web page. From this source they shared the following definition as they stated in the chat environment: "Counterbalancing can be defined as using all of the possible orders of conditions to control order effects (Cozby, 2009)."

In addition, they provided following explanations related to the counterbalancing: "An order effect is when the order of "presenting the treatments affects the dependent variable" (Cozby, 2009, 155). In a repeated measures design it is very important that the experimenter counterbalances all of the possible orders of conditions because the extent to which order is influencing the results can be determined. Counterbalancing can be used in experiments with three or more groups."

As the team finally decided in the chat environment, they reported that they considered 6 different orders to apply counterbalancing: "Condition (1-2-3), Condition (3-2-1), Condition (2-1-3), Condition (1-3-2), Condition (3-1-2), Condition (2-3-1). Where: Condition 1: no auditory stimilus Condition 2: 2 auditory stimulus per second Condition 3: 6 auditory stimulus per second."

ASSIGNMENT-7 Applying and Interpreting Manova

The assignment includes following statement:
A researcher is interested in identifying how psychology majors' knowledge of different aspects of psychology improved throughout the first three years of their undergraduate education. The experimenter took a sample of first, second and third year students and gave them five multiple choice tests (maximum possible score was 15 for each test) representing core areas in psychology: Statistics, Experimental Psychology, Social Psychology, Developmental Psychology and Psychiatry. The dataset for this study is in PsychUndergrads.sav
Check whether parametric assumptions for MANOVA are met by this dataset.
What can you conclude from the Multivariate Tests table? Is there an experimental effect? (Provide the test results table, state which test you picked and why)

MANOVA

Identifying Assumptions of Manova

A_S didn't know all the assumptions of Manova. In terms of his idea, they should apply levene's test and tests of normality as in previous homeworks. However, this was an incomplete knowledge. G_C explained the correct way of doing assumptions (line 52-54). According to his explanations, their process should cover performing normality in the dependent variables, and checking equality in sample size. For this purpose, they should do the manova, and look for the box's test. If the p value resulted from box test is non significant, then they can assume that homogeneity of variance is met. After these explanations, A_S gained understanding.

Line	Date	Post Time	Chat Message
36	1/9/2014	3:08 PM	G_C: for the next question, we need to check if the assumptions of manova are met.
37	1/9/2014	3:09 PM	A_S: yes... let me open the relevant ppt page :)
38	1/9/2014	3:10 PM	G_C: :) sure
39	1/9/2014	3:12 PM	A_S: Are there lots of assumptions or I'm wrong? :)
40	1/9/2014	3:12 PM	G_C: no, you aren't wrong :)
41	1/9/2014	3:12 PM	G_C: there are 2 more :)
42	1/9/2014	3:13 PM	A_S: oh my god
43	1/9/2014	3:13 PM	G_C: sorry 1 more
45	1/9/2014	3:13 PM	G_C: but we don't have to worry, i think they can easily be handled.
46	1/9/2014	3:15 PM	A_S: really? :) how :)
47	1/9/2014	3:16 PM	A_S: as we did in 2 homeworks before, I think we should do levene's test and tests of normality as in both previous homeworks :)
48	1/9/2014	3:18 PM	G_C: yes and no :)
49	1/9/2014	3:18 PM	G_C: sorry i just see your message above, hocam. By the way
50	1/9/2014	3:18 PM	A_S:oh:)
51	1/9/2014	3:18 PM	G_C: :)

52	1/9/2014	3:19 PM	G_C: hocam, now, yes to the normality test - but this time we need to look for normality in the dependent variables.
53	1/9/2014	3:19 PM	G_C: and for levene's test, i think we first need to check if the samples are equal in size. well, they are not.
54	1/9/2014	3:20 PM	G_C: so, here is what i believe we should do: we should do the manova, and look for the box's test. if the p value is non significant, then we can assume that homogeneity is met.
55	1/9/2014	3:20 PM	A_S: oopsss yes :)
56	1/9/2014	3:22 PM	A_S: hocam thanks a lot again :)
57	1/9/2014	3:22 PM	A_S: I got it now

Analysis of messages between lines 36 and 57 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. The initial message of G_C is respected as a trigger activity that aims to obtain ideas of members for the assumptions of Manova. A_S thought that they should apply levene's test and tests of normality as the assumptions. Since this was an insufficient understanding, G_C explained the correct way of doing assumptions between lines 52 and 54, which are considered in *idea generation phase*. In the last three messages, A_S indicated his understanding.

Applying Manova Test

A_S asked if they should apply assumptions and the manova test separately. On the other hand, G_C replied that the manova test produces all the results at a time. Then, for conducting the test, they decided to follow steps provided by the instructor. This discussion was performed in Turkish.

Line	**Date**	**Post Time**	**Chat Message**
81	1/9/2014	3:45 PM	A_S: lets start manova then :)
82	1/9/2014	3:46 PM	G_C: yes :)
83	1/9/2014	3:48 PM	A_S: anyway, it will perform preliminary analysis for us :)
84	1/9/2014	3:48 PM	G_C: ok, thanks hocam :)
85	1/9/2014	3:49 PM	A_S: your welcome hocam :)
86	1/9/2014	3:49 PM	A_S: now except year, we will put all data for dependent variable
87	1/9/2014	3:53 PM	G_C: yes
88	1/9/2014	3:54 PM	A_S: do you recommend to follow all steps hocam :)
89	1/9/2014	3:54 PM	A_S: or just do tests?
90	1/9/2014	3:55 PM	G_C: sorry hocam, i couldn't understand :(
91	1/9/2014	3:56 PM	A_S: sey yani hocam... manova icin gereken tum testleri girelim mi simdi? (the thing I mean … should we enter all the tests required for manova now?)
92	1/9/2014	3:57 PM	A_S: yoksa sadece assumptionlar icin kismi mi yapalim dedim ? (or should we only conduct the part for the assumptions?)
93	1/9/2014	3:57 PM	A_S: ben anlatamadim ki :) (I couldn't explain previously)
94	1/9/2014	3:57 PM	G_C: estagfurullah hocam (not at all)

95	1/9/2014	3:57 PM	G_C: :)
96	1/9/2014	3:58 PM	G_C: hocam, zaten boxs test falan hepsi manova ile beraber cikacak olmali; boylelikle hem b hem de c sorulari icin tablolar elimizde olur diye dusunuyorum. asil options ta neleri tickleyecegiz, ben yine hoca ne yaptiysa aynen tickleyecegim, bi bakalim neler cikacak (the results of box test will be provided with the manova results; in this way, we can obtain the tables for question b and c. Which options should we select? I will choose the ones selected by the instructor. What will be the results?)
97	1/9/2014	3:58 PM	A_S: hepsini yapalim isterseniz :) en iyisi o gibi zaten (lets do all of them if you accept :) the best may be that one)
98	1/9/2014	3:59 PM	G_C: :)
99	1/9/2014	4:00 PM	A_S: ben de buna katiliyorum hocam :) Follow the instructor :) (I agree with that one hocam :))

Based on the Progressive Knowledge Building Inquiry cycle, messages between lines 81 and 99 can be analyzed as follows. The initial message indicates the group's start to apply manova test and categorized as trigger activity. They *generated ideas* for the steps of applying the test in majority of the messages. In the message in line 91, A_S had question about selecting subtests of manova. G_C provided explanations in the message in line 96, which is considered in *idea generation* phase. In lines 97 and 99, A_S achieved understanding and agreed with the offers of G_C, which is categorized in *idea connection* phase.

Interpreting Results

Firstly, A_S considered the results of box's test and stated that significance is smaller than 0.05, hence the covariance matrices are roughly equal and the assumption is tenable.

For the homogeneity of variance, G_C stated that they do not have equal number of participants in each group. Therefore, they applied Box's test and found a non-significant value of p (p=,059, <,05). This test is nonsignificant, so they can assume that the homogeneity is met. A_S provided confirmation to these results and interpretation.

Line	Date	Post Time	Chat Message
108	1/9/2014	4:11 PM	A_S: hocam lets follow book and fill our parts then :)
109	1/9/2014	4:11 PM	A_S: first we should look box's test
110	1/9/2014	4:16 PM	A_S: since significance p<0.05 the covariance matrices are roughly equal and the assumption is tenable
111	1/9/2014	4:18 PM	G_C: yes, and i think that's why we will need to look for pillai test in the following question.
112	1/9/2014	4:19 PM	A_S: pofff :) I didnt look at it :)
113	1/9/2014	4:19 PM	G_C: that's ok hocam, i found it while i was reading the chapter :)
114	1/9/2014	4:21 PM	A_S: ahaha ok hocam :)
115	1/9/2014	4:22 PM	G_C: hocam would this be ok to write this for homogeneity? since we do not have equal number of participants in each group, after running a Box's test and see that we have a non-

			significant value of p (p=,059, <,05). This test is nonsignificant, so we can assume that the homogeneity is met.
116	1/9/2014	4:25 PM	A_S: sure hocam :)
117	1/9/2014	4:25 PM	A_S: this is exactly what I thought
119	1/9/2014	4:26 PM	G_C: great! :)

Analysis of messages between lines 108 and 119 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. In the message in line 109, A_S offered to apply box's test, and in the message in line 110, he provided the interpretation. These messages are considered in *idea generation* phase. In the following message, G_C provided agreement and indicated the use of pillai test in the next question. Hence, this message is categorized in *idea connection* phase. In the message in line 115, G_C provided interpretation about the homogeneity of variance, which is categorized in *idea generation* phase. In the remaining messages, A_S indicated his agreement.

The team considered to apply pillai test since they had unequal group sizes, and the Box's test results in a non-significant p value.

Then, G_C provided a comprehensive interpretation that "when we read the p value for Pillai's test, we can conclude that it is significant (p=,020). We can say that different aspects of psychology improve as the students get more educated. In other words, as the students are in their higher academic year, the more improved they are in terms of these five different aspects of psychology." A_S provided confirmation to these results and interpretation.

Line	Date	Post Time	Chat Message
131	1/9/2014	5:10 PM	G_C: welcome back hocam :)
132	1/9/2014	5:11 PM	G_C: hocam i just looked at the 3rd question, and i think i have some answers for that :)
133	1/9/2014	5:11 PM	A_S: super hocam :)
134	1/9/2014	5:11 PM	A_S: I was trying to conclude something but not yet :)
135	1/9/2014	5:12 PM	G_C: hocam can you please add the multivariate tests table to the wiki?
136	1/9/2014	5:13 PM	G_C: look at that table, we can say that 3. We looked at the pillai's because for the homogeneity assumption because we had unequal group sizes, and the Box's test results indicated a nonsignificant p value .
137	1/9/2014	5:12 PM	A_S: sure hocam
138	1/9/2014	5:13 PM	G_C: Here, when we read the p value for Pillai's test, we can conclude that it is significant (p=,020). We can say that different aspects of psychology improves as the students get more educated. In other words, as the students are in their higher academic year, the more improved they are in terms of these five different aspects of psychology.
139	1/9/2014	5:13 PM	G_C: is it true hocam?
140	1/9/2014	5:19 PM	A_S: hocam ellerinize saglik (hocam thank you)
141	1/9/2014	5:19 PM	A_S: gayet (quite) true

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 131 and 141 can be analyzed as follows. In the messages in lines 136 and 138 G_C provided the interpretations, which are categorized in *idea generation* phase. In the messages in lines 137 and 141, members provided confirmations to ideas.

In order to check the assumptions, G_C recommended conducting the normality test (line 60) and A_S agreed with this idea (line 61). According to the results of the normality test, G_C found that only significance value belongs to the developmental-2nd year students (line 62). A_S asked if G_C included three courses in the dependent list (line 63, 64). As a reply, G_C stated that she considered the courses as dependent and found p value for all courses larger than 0,05(line 65). A_S understood the result and then asked whether G_C considered results of Shapiro-wilk for normality (line 66,67). G_C responded that she applied Kolmogorov-smirnov test (line 68). A_S recognized that his results were different from the ones that G_C shared (line 69, 70). After reviewing his steps, A_S thought that the reason for the difference that he didn't split the file before the analysis (line 71). However, G_C stated that she also didn't split the file (line 72). G_C indicated her confusion and stated that they may consider the results of Shapiro-wilk since the Kolmogorov-smirnov results do not lead the team to acquire expected results (line 73). A_S accepted the idea of considering results of Shapiro-wilk since the sample size is low. According to the results of Shapiro-wilk, A_S found all the results normal (line 74,75,76). Yet, G_C experienced confusion while deciding on the appropriate test (line 77), therefore suggested continuing later on (line 78).

Line	Date	Post Time	Chat Message / Whiteboard Activity
60	1/9/2014	3:25 PM	G_C: firstly, we do normality using good old explore :)
61	1/9/2014	3:26 PM	A_S: ahaha ok lets start with it first:)
62	1/9/2014	3:30 PM	G_C: :) yes. i only have a significant value for the developmental-2nd year students.
63	1/9/2014	3:32 PM	A_S: didn't you include others to the dependent list hocam? :)
64	1/9/2014	3:32 PM	A_S: I mean the three courses
65	1/9/2014	3:32 PM	G_C: i did, but they are all >,05
66	1/9/2014	3:33 PM	A_S: ahaha ok :) I confused it :9
67	1/9/2014	3:33 PM	A_S: btw... you used Shapiro wilk?
68	1/9/2014	3:35 PM	G_C: no, Kolmogorov-smirnov
69	1/9/2014	3:37 PM	A_S: hmm... I got experimental psychology,
70	1/9/2014	3:37 PM	A_S: social psychology and development as normal
71	1/9/2014	3:38 PM	A_S: oopppsss... I didn't split my file :(
72	1/9/2014	3:38 PM	G_C: neither did I
73	1/9/2014	3:40 PM	G_C: I'm not sure but maybe we can look for s-w. you may be right because Kolmogorov-smirnov is leading us to nowhere
74	1/9/2014	3:42 PM	A_S: it leads us no where
75	1/9/2014	3:42 PM	A_S: and the sample sizes are low
76	1/9/2014	3:43 PM	A_S: and Shapiro wilk results are all p>0.05 :) a
77	1/9/2014	3:44 PM	G_C: :) of of :(
78	1/9/2014	3:25 PM	G_C: ,i have a wonderful suggestion: lets leave it there, and discuss it tomorrow :)

Analysis of messages between lines 60 and 78 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. In the first message, G_C offered to apply normality test and provided the results in message in line 62, which are considered in *idea generation* phase. In the messages in lines 63 and 67, A_S asked about the analysis. G_C provided responses in messages 65 and 68. In the remaining messages, they tried to generate ideas about the analysis but couldn't reach the solution as expected.

Wiki Reflection

Related to the assumptions of Manova, the team provided the results that they found for the Homogeneity of Covariance Matrices: "We assume that for each DV, the variances are roughly equal and the correlation between any two dependent variable is same in all groups. So we check if the population variance-covariance matrices of the different groups in the analysis are equal.

Since we don't have equal number of participants in each group, after running a Box's test and see that we have a non significant value (p=0.059, >0.05). This test is non-significant, so we can assume that the homogeneity is met."

Different from the chat discussion, the team provided explanations for the assumptions-Independence, Random Sampling & Interval Measure.

As they discussed in the chat environment, they provided the results of Pillai test as follows:

"We looked at the Pillai's because for the homogeneity assumption because we had unequal group sizes, and the Box's test results indicated a nonsignificant p value (p=,020, <,05).

Here, when we read the p value for Pillai's trace, we can conclude that it is significant (p=,020). We can say that different aspects of psychology improves as the students get more educated. In other words, as the students are in their higher academic year, the more improved they are in terms of these five different aspects of psychology."

Experience of the Team throughout Assignments

In this section, we analyzed the team-1's experience in variables and normality test concepts since they are common concepts among assignments of the course.

Progress of the Team Related to Variables Concept

The chat and wiki activities demonstrated that the team had the most successful experience in one of the topics of the variables concept. That is, the team correctly identified dependent and independent variables in each assignment until the last one. Yet, in the seventh assignment, the team experienced the problem of categorizing the variables as dependent or independent. Then, with the guidance of one member, the team could reach the solution.

In finding the categorical variables, the team generally showed good progress. In the first assignment, the team could define the nominal variables properly. Although they provided an inappropriate interpretation firstly, then they corrected it as the existence of categories for the nominal variables. In the second assignment, members had different opinions for the scale of gender: one member offered it in binary; the other offered it in nominal scale. During the chat session, the team didn't discuss about the difference between proposes. However, the wiki output demonstrated that the team came to an agreement and presented

proper solution by stating the gender as binary variable and existence two groups belong to the gender. In the remaining assignments (i.e. 4^{th} and 7^{th}), the team could correctly indicate variables with more than two categories as nominal.

While solving the initial assignments, the team experienced serious problems in detecting continuous variables (i.e. interval and ratio). In the first assignment, the team could correctly identify the task completion time in ratio scale. However, their rationale was not sufficient enough. They stated that "task completion time is shown in milliseconds and each response says something about the performance of each participant under a certain condition". Instead, they could mention the representation of equal intervals in the scale and the existence of meaning related to the ratio of values. In the second assignment, one learner had confusion in understanding scales of physical variables whether they should be ratio or interval. One of the team members guided that learner by providing definition of ratio together with proper examples. In this way, the topic became clear for the team. In the fourth assignment, the team categorized the test scores in ratio scale. However, this solution demonstrated that they couldn't understand the difference between interval and ratio scales. Since test scores have no true zero values, they should be considered in interval scale. Yet, the team's solution in the seventh assignment demonstrated that they gained progress and could correctly categorized test scores in interval scale.

Individual Progress of Team Members Related to Variables Concept

A_S: In the first assignment, after G_C offered the dependent variable, he indicated having the same idea. He could correctly categorize independent variable and detect the variable in nominal scale. However, he could provide reasoning related to his offers. In the second assignment, according to the chat log, he didn't provide any contribution while the group was discussing about the variable concept. In the fourth assignment, he indicated his agreement to the offers related to types (i.e. dependent/independent) and scales (nominal, ratio) of variables. In the fifth assignment, after G_C offered the independent variables, he indicated he thought in the same way. In the seventh assignment, he experienced problem while identifying dependent and independent variables. With the guidance of G_C, he could understand the solution.

G_C: In the first assignment, she correctly identified dependent variable. Then, she could categorize ratio and nominal variables properly. Although her reasoning for the nominal scale was appropriate, the interpretations for the ratio scale do not reflect the exact reasoning. She could mention the representation of equal intervals in the scale and the existence of meaning related to the ratio of values. In the second assignment, she could correctly categorize the gender variable in binary scale. However, she had confusion about the difference between ratio and interval scales. With the clarifications and example provided by Y_A, he could gain understanding. In the fourth assignment, she could identify types and scales of variables. In the fifth and seventh assignments, she could correctly detect dependent and independent variables.

Y_A: According to the chat log, he didn't provide any contribution in assignments 1, 5, and 7 related to the variables concept. In the second assignment, his offer of nominal scale for the gender variable was incorrect since it should be in binary scale. On the other hand, he could properly categorize ratio variables and provide explanation for the difference of interval and ratio scales. In the fourth assignment, after G_C indicated types and scales of variables, he could state his agreement to these offers.

Progress of the Team Related to Normality Test

While performing the early assignments, the team had lack of experience. But towards to the later assignments, the team showed progress in applying and interpreting tests of normality. The first activity that the team experienced development was employing the normality test appropriately. During the 2nd assignment, they didn't initially consider the cases while performing the analysis. By the mutual exchange of information, they recognized this as the essential analysis step of the normality test. In the 4th assignment, the team experienced confusion whether the splitting file is appropriate step before the normality test. One member thought that it is necessary but stated that he obtained weird results when he split the file. Another member had the different opinion and explained the steps of analysis without splitting. After the descriptions, the team could apply the test and reach the proper results of the normality test. In the 5th assignment, one member stated her problem of obtaining meaningful results and the other member suggested to explain analysis steps of the test. Then, in the remaining assignments (i.e. 6th and 7th), the member having problem could produce results. This demonstrated that knowledge was shared among the team members and they progressed throughout assignments.

Normality results belong to two different tests: Kolmogorov-Smirnov (K-S) and the Shapiro-Wilks (S-W).In some assignments, the team's confusion was observed in detecting the appropriate test for cases. In the 4th assignment, the team's first opinion was towards considering the K-S test. By providing explanations and resources, one member proposed the S-W as the proper test because of the small sample size. Therefore, the team could come to decision of selecting the S-W as the appropriate one. In the 5th assignment, the team directly applied the K-S test without discussing about it. Similarly, there was no confusion in the 6th assignment related to the selection of the test. However, in the 7th assignment they couldn't come to a decision in choosing the appropriate normality test.

Individual Progress of Team Members Related to Normality Test

A_S: In the second assignment, he shared the normality results, which were produced without considering the cases during the analysis. With the notification of G_C, he recognized this as the essential analysis step and then reapplied the normality test. In the fourth assignment, he was confused about splitting data before the analysis. Y_A didn't propose splitting process and directed the team to perform the analysis in this way. A_S proposed to consider the results of S-W test by explaining the size of the sample and providing an appropriate web source. In parallel to this suggestion, he provided an example interpretation of normality results. In the fifth assignment, he could perform the normality test and explained steps of analysis to G_C. Then, he shared the normality results and wrote the interpretations. In the sixth assignment, each member conducted the normality test individually. Then, G_C shared the interpretations but could not correctly interpret the p values. On the other hand, A_S had no warning and provided the same interpretation as her. However, the wiki output demonstrated that he shared the correct results of the normality test and corresponding interpretations.

G_C: In the second assignment, she informed the team about the necessity of considering cases while performing the normality test. In this way, the team could reapply the test and reach the proper the results. On the other hand, she stated having a problem in interpreting the significance value produced by the normality test. However, in terms of the wiki output, she could provide correct interpretation of p values and provided appropriate reasoning of

normality test results. In the fourth assignment, she could conduct the test with the guidance of Y_A. Yet, she had lack of knowledge in selecting the test they would report. A_S proposed to consider the results belong to S-W test by stating the sample size less than 30. Hence, she could gain understanding about the criteria they should consider in selecting the test of normality. In the fifth assignment, she listed the assumptions they need to focus on. But, she didn't know the steps of analysis of the normality test. Therefore, she obtained help from A_S about the steps to be followed. The sixth assignment, she could perform the analysis without the guidance of anyone, which shows her progress in time.

Y_A had contribution only in the fourth assignment. He proposed to list of steps in obtaining results of the normality test.

Course Grades of Team Members

A_S: Grades of A_S in course exams are provided below.

Grade in Midterm Exam: 54/100

Grade in Final Exam: 36/100

In general, A_S was not successful enough according to the exams of the course.

About the variability concept, he correctly identified dependent and independent variables in the midterm exam. On the other hand, he couldn't provide an answer to the question about the scales of variables. The same insufficiency of A_S was observed in the final exam. Similarly, he correctly categorized variables as dependent and independent, but couldn't identify their measurement scales. Therefore, he obtained half of the scores in the question about the variables. A_S's exam performance reflects his success and difficulties observed during the chat sessions. That is, he generally offered correct solutions for the dependent and independent variables, but he didn't provide any solution for the scales of variables in most of the assignments.

Related to the normality test, he appropriately interpreted the results in the midterm and final exams. A_S also demonstrated successful execution and interpretation of the normality test during the chat activities. While solving related questions, he was the member who generally conducted the normality analysis and reported the interpretations in the group.

G_C: Grades of G_C in course exams are provided below.

Grade in Midterm Exam: 51/100

Grade in Final Exam: 69/100

About the variability concept, she correctly identified variables and their scales in the midterm exam. Although she correctly categorized variables as dependent and independent in the final exam, she couldn't correctly identify their measurement scales. G_C had similar experience during the chat activity. That is, she generally offered correct solutions for the dependent and independent variables, and she often provided appropriate solutions for the scales of variables in some of the assignments.

In the midterm exam, she interpreted the results of the normality tests incorrectly. In the final exam, she demonstrated progress and correctly interpreted the normality test. During the chat

activity, she generally faced with problems in interpreting the results of a normality test, and the guidance G_C received from other members of her team seemed to have helped her improving her understanding of the normality test and its interpretation..

Y_A: Grades of Y_A in course exams are provided below.

Grade in Midterm Exam: 74/100

Grade in Final Exam: 70/100

Y_A correctly identified the scales of the variables. In the midterm, in one question he experienced problems in identifying the dependent and independent variables. In the final exam, he was able to identify the dependent and independent variables but not their scales. In the chat activity, we observed that Y_A generally didn't contribute much to the discussions on variable types and scales. In one of the assignments, he provided the correct solution for the scales of variables. He also correctly categorized the ratio variables and explained the difference between interval and ratio scales.

Y_A interpreted normality tests correctly both in the midterm and the final exams. In the chat environment, he had made a contribution related to this topic only in the fourth assignment, where he proposed the list of steps in obtaining results of the normality test.

Overall, 2 of the member of team-1 were actively participating in the collaborative activities, whereas Y_A's participation was rather inconsistent. Participation is in general considered as a very positive factor in CSCL, which should be supported and promoted, as it is believed to positively contribute to students' knowledge building. However, team-1's raw participation counts do not relate to their performance on the midterm and the final, and the relatively low scores of the more active members of the team fails to support the expectation that increased participation brings better learning outcomes. This case suggests that the quality and the depth of the participation should be taken into account to better account for the relationship between process and outcome measures in a CSCL environment.

Research Question 5- How are the process measures devised by learning analytics methods and the measures for overall learning outcomes relate to each other?

The last question is concerned with the relationships between process and outcome measures. The process measures include basic descriptives related to the group activities of each team, such as the number of chat messages posted, the number of whiteboard contributions made, the number of wiki edits performed, and the time spent during chat. The outcome measures constitute the midterm and final grades that were measured individually, a homework grade measured at the group level as well as a composite score used for grading purposes. Table 14 summarizes the measures obtained from the sample of 15 students.

Table 14 Measures Obtained from the Sample of 15 Students

Handle	Team	Mean Chat Messages	Total Chat Messages	Mean Chat Duration	Total Chat Duration	Mean Wiki Edits	Total Wiki Edits	Mean Whiteboard Activity	Total Whiteboard Activity	Final	Midterm	Homework	Cum Grade
A_S	1	116.43	815	335.67	2014	15.57	109	6.29	44	36	54	85	61
G_C	1	83.86	587	315.50	1893	9.86	69	1.14	8	69	51	85	70
Y_A	1	21.43	150	106.33	638	2.29	16	0.00	0	70	74	80	75
H_A	2	167.50	1005	179.83	1079	12.71	89	2.29	16	81	47	90	74
M_G	2	47.17	283	172.00	1032	3.43	24	0.67	4	52	36	80	58
Z_B	2	121.50	729	179.50	1077	9.29	65	0.60	3	89	86	90	89
F_I	3	68.33	410	209.00	1254	7.75	31	1.50	9	97	87	95	93
N_M	3	58.67	352	207.50	1245	13.25	53	0.00	0	95	96	95	95
C_K	4	38.00	114	161.33	484	14.00	14	2.00	14	69	68	75	71
F_A	4	58.17	349	138.50	831	0.00	0	0.50	3	59	52	90	69
F_B	4	44.40	222	77.20	386	7.50	30	7.57	53	97	82	90	90
F_K	4	25.00	125	77.20	386	3.00	12	0.67	4	79	68	90	80
M_S	4	57.57	403	111.57	781	0.00	0	0.86	6	92	92	95	93
A_B	5	115.33	692	211.43	1480	12.86	90	4.83	29	86	86	100	92
D_C	5	85.67	514	204.14	1429	1.43	10	0.43	3	78	70	100	84
H_K	5	114.00	684	208.14	1457	14.14	99	0.00	0	85	78	100	89

Multiple regression models were used to explore if there were any predictive relationships among process measures and each individual outcome measure. A multiple regression model using the average chat messages, chat duration, wiki edits and whiteboard contribution significantly predicted the homework grades, $F(4,11)=6.70$, $p<.01$. Table 15 summarizes the regression parameters for each predictor.

Table 15 Regression Parameters for Predictors

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	87.347	3.356		26.029	.000		
	Mean Chat Messages	.100	.038	.542	2.618	.024	.616	1.624
	Mean Chat Duration	-.021	.022	-.208	-.976	.350	.581	1.721
	Mean Wiki Edits	-.715	.300	-.526	-2.382	.036	.542	1.844
	Mean Whiteboard Posts	2.501	.591	.775	4.232	.001	.789	1.268

The regression coefficients table suggests that mean chat messages posted ($t(4)=2.62$, $p<.05$), the mean number of wiki edits ($t(4)=-2.38$, $p<.05$) and the mean number of whiteboard posts ($t(4)=4.23$, $p<.01$) are significant predictors of homework grades. The

standardized coefficients suggest that there is a positive relationship between the mean number of chat and whiteboard postings with homework performance. However, surprisingly there is a negative relationship between the mean number of wiki edits and the homework grades, which suggests that students who edited the wiki more did not necessarily get high homework grades. This result is probably due to the fact that not all wiki edits are informative or substantial.

Multiple regression analyses conducted on midterm, final and cumulative grades of the students showed that the process features are not significant predictors. In other words, when shallow process measures are considered, we have little predictive power for the final learning outcomes that were mainly assessed at the individual level. Altogether, these multiple regression models point out the limitation of simple models that relate basic counts related to the process of collaboration to learning outcomes. In an effort to provide a more reasonable picture for the practitioners, we need to go beyond these shallow measures.

CHAPTER-5

DISCUSSION AND CONCLUSION

A significant advantage of CSCL environments is that they provide system logs that record details of interactions experienced among students. Since these logs capture instances where learners ask questions, look for information and make reasoning together, learning becomes visible to the instructors. The growing use of computer-mediated communication channels such as social networking, chat, instant messengers and wikis as components of CSCL applications has resulted in large repositories of such learning interactions. Although CSCL tools offer advantages to eliminate the student isolation issue, such environments also result in some methodological and pedagogical challenges. For example, analyzing hundreds of lines of collaborative interactions of student teams is a time consuming task for instructors. Therefore, instructors generally focus on learning outputs while evaluating learner performance in CSCL environments. In this kind of evaluation, each team member is often assumed to equally contribute to the final deliverable, and each obtains the same grade as a result of evaluation. Yet, dividing students into groups and requiring them to collaborate do not simply result in equal participation and effective discussion. Thus, a detailed monitoring of the collaboration process is necessary to support teachers to perform a fair assessment of group work and provide support when needed (Wang, 2009).

In this study, we aimed to bring together basic ideas from text-mining and interaction analysis methods that will help instructors follow the conceptual development of their students with respect to the specific learning goals of their course. For that purpose, we used linguistic markers in the course of a discussion in chat to mark segment boundaries. This step provided the much-needed pre-processing to improve the document similarity analysis performed in the next stage. The keywords in question statements can be then used at this point to navigate through chat logs. The segments corresponding to questions help teachers identify those interactional episodes where the teams discussed the key statistical concepts. Capturing such instances across multiple log files would give the teacher a much better view of the progression of ideas across multiple sessions and teams, as well as the difficulties students might be having with specific concepts and methods.

In this study, our major purpose is investigating a group of learners' knowledge building process during their online collaboration in a CSCL environment in the context of a course. Our focus in on learners' task related discussions which reflect learning groups' collaborative studies about the assignments of the course. In addition, we considered analyzing wiki content and reflections of learners' chat discussions to the wiki output.

We conducted the study in the context of a graduate level Research Methods & Statistics course, which introduces basic concepts of empirical research and experimental design. The course was structured in a way that the instruction was provided face-to-face and assignments were collaboratively completed online. Learning groups of the course studied on course assignments collaboratively by using the VMT system. The aim of assignments was to help students develop their understanding of key statistics concepts through collaborative studies where they attempted conduct a specific type of analysis by using the SPSS software. In each assignment, learning groups were initially required to perform online chat meetings, then publish their findings as co-authored wiki documents. In order to achieve purposes of the study, we obtained three learning groups' chat log and wiki content data that VMT system produced as a result of their collaborative studies in seven assignments of the course. After obtaining data, we employed our methodology and presented results for the team-1.

Research Question-1 - Which segments of chat logs reflect learners' collaborative studies on assignments?

Chat logs were produced for each assignment separately and their content consists of a set of topics in mixed format. Hence, one can not immediately understand which question was discussed in which part of the chat discussion. Therefore, we decided to divide chat logs according to their focus and identify the topic of each chat portion.

For the division of chat logs, we considered segmentation analysis and employed a set of segment starting methods used by the participants to initiate new topics in chat messages as keywords. By using these keywords, we could identify approximately 90% of segment starting messages. On the other hand, remaining messages containing these keywords were observed as deceptive segment starters. Hence, after we marked the keywords in the entire chat transcript, we manually checked marked messages in order to identify correct segment boundaries. Consequently, deceptive segment starters were unmarked and considered within neighboring segments including other messages. Similar to our segmentation analysis, Khan, Fisher, Shuler, Wu, & Pottenger (2002) proposed and applied patterns for the identification of the beginning of new conversation threads. The patterns were developed by the observations of human experts and categorized as positive and negative patterns. With the use of positive patterns, they positively discover the starts of threads. However, employing only positive patterns lead to some false positives which don't really indicate the beginning of a thread. This result was consistent with our observations on deceptive segment starters. We removed the false positives by manually checking each starting message. On the other hand, in Khan et al. (2002) study, the use of negative patterns helped them to get rid of the deceptive thread starters.

The content of chat logs consists of a set of topics, which may relate to social issues, coordination issues or questions of an assignment. Social issues reflect learners' social interaction in the group, and coordination issues reflect learners' talk about planning subsequent online meetings. Learning groups conduct assignment related activities while collaboratively solving a given problem. A similar categorization of chat messages were observed in the study of Janssen et al. (2007), which analyzed learners' task related, social, coordinating/regulating, and technical activities in a chat environment. The different category in comparison to our study is technical activities, which were performed to manage

software related challenges in the collaborative learning environment. This kind of activity was considered under the non-task related category in our study.

After the segmentation analysis and the approval of segment starting messages, we obtained chat segments, each of which consists of various number of ordered chat messages. According to the results of the team-1, they have performed several online chat meetings, hence their discussions cover various number of chat segments. The segments mainly consist of learners' discussions related to the requirements of the assignment as well as coordinative and social issues. The chat topics are broadly categorized as task related and non-task related. Task related topics represent discussions of learning groups for the purpose of solving questions provided in the assignment. The topics are treated as non-task related if talks of learners aim to socialize or to share experiences in their daily lives. Yet, we considered segments related to the learners' studies in solving questions. For this purpose, we checked the contents of the segments and tried to find out the ones focusing on the questions of the assignments. As a result of the analysis, we identified team-1's task related segments for each assignment of the course. Approximately 50% of team-1's chat segments were found as task related. This is the result addressing the 1st research question in which we aim to identify segments of chat logs that reflect learners' collaborative studies on the assignments.

Research Question-2 -Which target concepts are discussed within the task-relevant segments of chat logs?

Through the analysis in previous stage, we categorized chat segments as task related and non-task related. In this stage, our analysis considered segments in which question related discussions were held and ignored the remaining ones. Although we identified task related segments, we didn't have the idea of which question was discussed in which segment. This is the motivation for detecting topics of segments. That is, we could match the chat parts with their topics with the help of our topic detection methods.

For the purpose of detecting the topic of each segment, we focus on frequent keywords that the teams utilized while they were collaboratively working on solving questions. These keywords are assumed to capture the major focus of the questions. By employing two mode network analysis, we considered three teams' chat discussions about the questions and identified a set of indicative words for each question. This process provided lists of keywords for questions on the basis of each assignment. Similar to our approach, Ozyurt and Kose (2010) have also identified indicative words for different topics of chat conversations and applied supervised methods to categorize chat topics. Their methodology covered feature selection for the determination of indicative words and terms. Since their study considered chat mediums for general discussions, the resulted indicative words belong to topics like sports, flirting, entertainment, etc. Our study was implemented in the context of a course, hence our keywords are parallel to the questions included in the assignments. More importantly, our method including a two mode network analysis to find the indicative words of questions is a novel approach for the CSCL and topic detection area.

In order to identify which segment maps onto which question (i.e. topic), we conducted a comparison among segments and indicative words of questions by employing latent semantic analysis (LSA). In this way, we produced chat segments with their corresponding questions and concepts as the focus of questions. This addresses our second research question that aims to identify which concepts are discussed within the task-related segments of chat logs.

According to the literature review, supervised methods generally covered Naïve Bayes, k-NN, and SVM algorithms while categorizing chat topics, which are frequently used topic detection methods. In this regard, our methodology is different from the current studies.

We provided the results of topic detection for the team-1. According to these results, we could match 45 segments with their questions among 48 segments. Only, the topics of 3 segments couldn't be detected with our analysis. The high detection capability demonstrated the success of our methodology of topic detection in this CSCL context.

Research Question-3- How learners accomplish conceptual development during their collaborative study in chat environments?

Once we identified chat segments and their corresponding concepts, we became ready for accomplishing our purpose of analyzing learners' conceptual developments in their collaborative studies. Within the context of collaborative learning, learners' progress is based on their interaction in the group. In order to reveal instructional gains in collaborative learning, researchers follow the steps of collecting the protocol data of the session, exploring cores of the data and inspecting benefits in the data (Inaba, 2002). Similarly, our study follows these three steps and provided results appropriate for addressing the first three research questions accordingly.

In order to address the third research question and understand how learners accomplish conceptual development during their collaborative study in chat environments, we aimed to inspect the verbal interaction among the learners by considering their knowledge construction process as captured in the VMT system while they were discussing assignment-related content. We analyzed contents of task related segments provided in the previous stage. By employing the Progressive Knowledge Building Inquiry cycle (Hakkarainen, 2003; White & Frederiksen, 1998), we examined how learning groups developed their understanding of key concepts of statistics during their collaborative activities spanning the entire semester. The Progressive Knowledge Building Inquiry cycle starts with a trigger activity and consists of four main phases; (a) idea generation, (b) idea connection, (c) idea improvement, and (d) rise above. Our results demonstrated that learning groups' discussions generally initiated with the trigger activity which involves the statement or number of the question. After the trigger activity, learners' activities generally continued with idea generation and idea connection phases. Members' proposed solutions to the question indicated the phase of idea generation. Their comparisons and decisions related to the solutions illustrated the idea connection phase. On the other hand, idea improvement and rise above phases were seldom in our results. In the idea improvement phase, learners employed appropriate sources for the solution of the question, which wasn't common preference of our learners. The reason may be that they preferred to benefit from the knowledge and experience of their peers in a collaborative learning environment. In the rise above phase, learners reflected on their current understanding, which was observed only in one case of the chat discussions. This finding is consistent with the study of So et al. (2010), which applied content analysis to Knowledge Forum postings in order to investigate learning groups' improvement in their ideas. Their results demonstrated that learners lacked the ability of enhancing their ideas and citing sources in their solutions.

We focused on the interactional content where the "variables", "normality test" and "statistical test" concepts were discussed by the team. Our purpose is to understand how learners made progress throughout chat activities while working on these concepts. We

provided the corresponding results for the Team-1. During their collaboration in the chat, we mainly demonstrated learners' conflicts, explanations, opinions, and final solutions for the questions. Additionally, we examined sufficiency of their finalized solutions as the answer of the questions. To summarize, these results demonstrated the instructional benefits that learner gained in their collaborative study.

The community of inquiry model was developed as a comprehensive framework for online learning (Garrison, Anderson, & Archer, 2000).The framework involves three elements (i.e. social, teaching, and cognitive presence) as well as categories and indicators to explain each presence and to direct the coding of transcripts (e.g. learners' forum postings). Social presence refers the ability of an individual to project himself and form personal relationships. Cognitive presence is defined as "the exploration, construction, resolution and confirmation of understanding through collaboration and reflection in a community of inquiry". Teaching presence refers to the design and guidance of cognitive and social processes in order to achieve important instructional outcomes (Garrison, 2007). Community of Inquiry Coding Template was provided in the Table 16.

Table 16 Community of Inquiry Coding Template

Elements	**Categories**	**Indicators (examples only)**
Cognitive Presence	Triggering Event	Sense of puzzlement
	Exploration	Information exchange
	Integration	Connecting ideas
	Resolution	Apply new ideas
Social Presence	Emotional Expression	Emotions
	Open Communication	Risk-free expression
	Group Cohesion	Encouraging collaboration
Teaching Presence	Instructional Management	Defining and initiating discussion topics
	Building Understanding	Sharing personal meaning
	Direct Instruction	Focusing discussion

Cognitive presence is similar to Progressive Knowledge Building Inquiry cycle that we applied on learners' messages in order to understand their level of knowledge construction. Although they offer similar categorizations, cognitive presence doesn't consider a category similar to rise above category which investigates learners' reflections on their learning. In this regard, our methodology additionally considers the learners' advanced level activities in their collaborative studies. Our study doesn't consider the social presence and teaching presence aspects. As we stated in the methodology, we focused on learners' task related discussions and their knowledge constructions. This can be one of the limitations of our study. The future study may cover social presence and teaching presence to prevent this limitation.

Research Question-4- How are the contents of chat discussions and wiki postings relate to each other?

Wiki output is organized in parallel to questions of an assignment. Therefore, each wiki segment directly maps onto a question of an assignment. For each question, we initially employed interaction analysis to chat segment and then applied the content analysis to wiki output. We compared the wiki content with the solutions proposed in the chat environment, hence explored the similarities and differences in the finalized wiki solution in comparison to the solution decided in the chat environment. Moreover, we investigated the sufficiency of the provided content for the solution of the question. In this respect, our analysis is consistent with the completeness aspect of the final product of the assessment framework developed for the assessment of the wiki based group work (Putro, Carbone, & Sheard, 2014). Through the completeness attribute, the framework investigates the sufficiency level of the final product in comparison to task specifications. On the other hand, the framework also considers the integration and synthesis of individual contributions under the cohesiveness attribute, which can be integrated to our methodology as a future study.

On the basis of each question that team-1 discussed in the chat, we provided the results of wiki content analysis after the interaction analysis of their chat discussions. As in the previous stage, we focused on the wiki content where the "variables", "normality test" and "statistical test" concepts were included in the solution of the questions. After providing the results of interaction analysis related to these concepts, we presented the content analysis results of wiki output. While some decisions done in the chat environment were directly reflected on the wiki content, some additions or removals were done in the wiki content which did not appear in the chat discussions. The content analysis of wiki output allowed us to identify similarities and differences in the finalized wiki solution in comparison to solution decided in the chat environment. Additionally, we revealed the adequacy of the wiki content provided for the solution of the question. These results are important to understand efficiency of team-1's chat discussions in these concepts and solving questions.

Research Question 5- How are the process measures devised by learning analytics methods and the measures for overall learning outcomes relate to each other?

We investigated the relation between process measures and learning outcomes and found out that there is a positive relationship between the mean number of chat and whiteboard postings with homework performance. This result is in consistent with the study of Zafra, Romero and Ventura (2011) which investigated effect of learner activities in learning management system to their success in the course. According to their results, students involved more in discussion forums successfully completed the course.

On the other hand, the results demonstrated that there is a negative relationship between the mean number of wiki edits and the homework grades, which suggests that students who edited the wiki more did not necessarily get high homework grades. This result is probably due to the fact that teams generally gave the role of reporting solutions to the ones who did less contribution in the chat environment. This can be interpreted that members having lack of chat contributions didn't acquire deep knowledge about the concepts, hence obtained lower homework grades.

According to multiple regression analyses conducted on midterm, final and cumulative grades of the students, the process features were not found as significant predictors. That is,

when shallow process measures are considered, we have little predictive power for the final learning outcomes that were mainly assessed at the individual level. Altogether, these multiple regression models point out the limitation of simple models that relate basic counts related to the process of collaboration to learning outcomes. This supported our approach of integrating the content analysis to investigate the quality of learner contributions.

Students were not told that their collaboration process would be graded. As a future study, changes in interactions can be investigated when learners knew a learning analytics application would trace their participation for grading.

Contribution of the Study

Implications for Researchers and Instructors

In this study, we mainly analyzed learners' collaboration process according to the knowledge building theory. As we have noted before, tracking and analyzing all collaborative interactions of student teams is a time consuming task for instructors (Dascalu, Chioasca, &Trausan-Matu, 2008). Therefore, instructors tend to focus on learning outputs while evaluating learner performance in CSCL-environments. In order to overcome this drawback, we offered methods that will facilitate instructors' work in investigating the collaboration process. Besides, we analyzed the content of learning output in order to reveal the reflections of the collaboration process on the learning product. In other words, through the proposed methods we both analyzed collaborative processes and their products. This is aligned with the view that assessment should provide support to enhance both the process and deliverables of collaboration (Collazos, et al., 2007).

In a CSCL environment, the teacher typically takes the role of a regulator/facilitator who mainly monitors the activities and provide guidance as needed. Regulation can be conducted for the "interaction of between the student and the teacher, among students, between the students and the technology, or learning environment" (Orvis, 2008). For this purpose, the teacher can employ various strategies such as asking students to provide general information to introduce themselves to the group, assigning discussion questions for group work, and investigating learners' level of technology knowledge. Teachers' monitoring of student discussions may enhance the engagement of students with the learning process. The teacher may ask learners to explain their unclear responses in discussions. In addition, the teacher may provide feedback to students who are not active in the discussions and make sure that all students are paying attention to each other. Guidance role supports the instructors in a way that they can direct learners according to cognitive aspects of learning. Although participation of the teachers in CSCL environments tend to increase the contributions of learners to the discussion, intrinsic motivation was found to be the most significant factor for learning through effective participation (Rienties et al., 2009). According to the Self Determination Theory (SDT) by Deci and Ryan (1985), motivation is categorized as intrinsic and extrinsic. Intrinsic motivation is affected from feelings of competence, sense of autonomy, and sense of relatedness.

Methodology of our study can be used in various ways. Similar to our process of finding methods for the segmentation of chat logs, instructors or researchers can investigate their chat corpus to reveal such methods. These methods will facilitate the work in dividing long chat messages into segments. In order to detect topics of chat segments, the use of indicative words and their comparison with chat segments by the use of LSA will help the researcher to

detect topics discussed in the chat environment. Interaction analysis related to the concepts of the course will enlighten the instructor about learners' level of engagement with collaborative knowledge building processes. Analysis of wiki content will provide instructors with the results related to the reflection of chat discussion to learning output.

Implications for Practice

As future work, collaborative system designers can develop a teacher dashboard which consists of a set of modules implementing our proposed methodology. In the first module, the teacher initially uploads the log file which covers a team's chat messages for the purpose of solving questions of an assignment. Then, the system marks potential segment boundaries by considering keywords and phrases identified as the segment starting methods. The instructor should review all segment starting messages and confirm the appropriate ones. According to the confirmed segment starting messages, the system performs segmentation, hence chat segments are generated. In order to match segments with questions, the module explores keywords of questions and applies LSA. The second module can be designed for showing contributions of learners to questions and listing topics (questions) discussed during the chat. The instructor firstly selects the team and assignment. According to this selection, the system demonstrates the time that each member spends in the chat and total messages sent by each member. In addition, the system lists the topics discussed by the team while collaborating to solve the questions of the assignment. The instructor can select any topic to show the corresponding chat log. In this way, he can review student contributions to the question and their conceptual developments.

Reliability of the Study

Reliability of Segmentation Analysis

In order to investigate reliability of segmentation analysis, we used two coders (first author and one researcher) and calculated two indices as stated in the study of Strijbos and Stahl (2007):

- For the assignment of a thread or not by both coders (% thread);
- For the assignment of the same thread whenever both assigned a thread (% same).

Table 17 below provides results of the reliability trial for the pair of coders. The trial consists of 159 chat lines.

Table 17 Results of the Reliability Trial

Pair	% Thread	% Same
1-2	.72	.77

The CSCL field doesn't offer a threshold value for the agreement reliability of segmentation (De Wever et al., 2006; Rourke, Anderson, Garrison, & Archer, 2001), nor the area of content analysis (Neuendorf, 2002; Riffe, Lacy, & Fico, 1998). Based on different views in the literature, a range of .70 -.80 for proportion agreement can be used as the criterion value. The results demonstrated that both coders detected a thread in 72 % of all cases and 77 % of

assignments are identical. According to these results, we can say that the reliability of segmentation analysis fits the range of .70 -.80.

Reliability of Topic Detection

For the investigation of reliability of our topic detection approach, we considered the interrater reliability and compared topic assignments conducted by manually and LSA method. In this comparison, we considered topic assignments done for the segments of team-1 in seven homeworks. Of all the assignments, the percent agreement was found as 77%, which fits the range of .70 -.80.

Reliability of Content Analysis

In order to check reliability of our content analysis, we employed the interrater reliability and compared interpretations done by two researchers. In this comparison, we considered interpretations conducted for the segments of team-1 in one homework. Of all the interpretations, the percent agreement was found as 87%, which highly satisfies the reliability.

Assumptions of the Study

We accepted the following assumptions in this study:

- Teams used VMT system for their collaborative studies.
- VMT system worked properly and responded needs of learners during their studies.
- Teams collaboratively studied on at least one question of an assignment.
- Teams provided solutions of the result of their chat discussions in the wiki environment.
- The data were recorded and acquired properly.
- The measures used in the methodology were reliable and valid.

Limitations of the Study

One of the limitations of this research was its scope. The scope of this study was limited to a graduate course of Informatics Institute in a public university in Ankara, Turkey.

Other limitation was that we considered and analyzed data of three teams out of five teams in the course. We selected three teams because remaining teams didn't perform online meeting for the solution of some assignments. The future study could cover whole teams in a course with the obligation of teams' complete participation to each online meeting.

The chat corpus had two major challenges for the analysis. That is, it consisted of non-English words and it had noisy structure. Therefore, we performed preprocessing of data before performing the chat analysis. As the first step of preprocessing, we categorized chat messages according to their language. The categorization demonstrated that 95 % of the discussion was in English language. Learners preferred to employ Turkish in social messages. This was an expected behavior since learners may prefer to use their main

language in social issues. Yet, we considered conversations about task related issues. Hence, we removed chat messages in Turkish language and kept the ones in English language. Consequently, the resulted chat corpus contains 95% of initial chat messages produced by teams 1, 2, and 5. The noisiness in chat corpus was the result of misspellings and abbreviations. Therefore, as the second step of preprocessing, we transformed misspelling words and abbreviations to their correct forms. By the help of these procedures, the chat data became ready for the analysis.

During the analysis stage, we faced with some challenges. Use of keywords for finding segment starting messages during segmentation analysis resulted in some deceptive starting messages. Therefore, we needed to check all the potential chat messages containing keywords and identified the actual segment starting ones. The subjects were graduate students whose proficiency in English is probably higher than undergraduates. Since English was their second language, some of the markers for segmentation may work slightly differently as compared to native English speakers.

After the division of chat log into segments with these segment starters, we recognized that contents of all the segments were not related to learners' studies in solving questions. Hence, we investigated contents of segments one by one, and categorized them according to their purpose. The segments without the purpose of solving questions were removed from our analysis. Through our method of detecting topics of segments, we couldn't match a small number of segments with their corresponding questions. Therefore, we manually investigated contents of these segments and identified their matching questions. By the help of interaction analysis, we analyzed learners' knowledge building in three concepts of the course such as variables, normality test and statistical tests. The future study could investigate collaboration process of learning groups in all concepts of a course. Analysis of wiki contents was performed according to chat discussion. That is, wiki content provided for a question was analyzed if this question was discussed in the chat environment. The remaining wiki outputs were out of the consideration of our study.

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APPENDICES

APPENDIX A: ASSIGNMENTS

Assignment1

In an eye tracking experiment a researcher asked participants to solve two puzzles in 3 different conditions; namely picture, blank and fixation. 94 subjects attempted two different puzzles called Towers of Hanoi and River Problem. The task completion times and the responses provided by the participants are displayed in cogs536_hw1.sav.

In the Towers of Hanoi (TOH) puzzle the goal is to move all the disks on peg A to peg C so that the disks will appear in the same order in size (i.e. smallest on top). A larger disk cannot be placed on top of a smaller disk at any intermediary state of the solution. Given this restriction the participants were asked to figure out what would be the minimum number of moves required to reach the desired state (i.e. all disks are on peg C, ordered from smallest to largest).

In the river problem (RP) subjects are given a situation where a man buys a sheep, a wolf and a box of cabbage from a village across a river. The man has to use a boat to return home, but the boat can only load one of the sheep, wolf and the box of cabbage at a time. If he leaves the wolf and the sheep on the same side, the wolf will eat the sheep and if he leaves the sheep and the cabbage on the same side alone, the sheep will eat the cabbage. Subjects are asked what would be the minimum number of trips required to pass all items across the river without losing any one of them.

Each participant was informed about the rules of the puzzle and then randomly assigned to one of the puzzle groups, and then to one of the picture, blank and fixation conditions. In the picture condition, subjects were presented a picture that represents the initial state of the problem as a visual aid. In the blank condition subjects look at a black screen after they finish reading the instructions. In the fixation condition participants have to fixate on a cross sign located at the center of the screen (i.e. their eye movements were restricted) while they are thinking about the problem.

In each condition participants pressed the SPACE bar when they are ready to report the answer. The duration between the slide presenting the question and the key press is considered as the task completion time. Participants then entered their answers into the box that appear after they press the space button.

Given the description above, answer the following questions with your teammates:

Question 1. (25 pts) Basic Design
a. What are the minimum number of steps required to solve the river problem and the Towers of Hanoi?

b. State the design of the study. In other words, describe if this is a cross-sectional, experimental, or correlational study. Justify your choice.
c. What are the dependent/independent variables? What do you think is the goal of this study?
d. On what scale are the variables measured (i.e. nominal, ordinal, interval, ratio) and why? Note: don't just say that a variable is measured at the interval scale, but also justify your answer by mentioning the properties satisfied by that variable.

Question 2. (25 pts) Descriptives for task completion time:
a. Report the measures of central tendency (mean, median, mode) and dispersion (variance, SD, SE, skew, kurtosis) for task completion time values for each puzzle type and condition in a table (e.g. for TOH, you need to compute these for TOH-picture, TOH-blank, TOH-fixation groups separately, and you should do the same for RP). You may use the following format for your table:

	TOH-Picture	TOH-Blank	TOH-Fixation	RP-Picture	RP-Blank	RP-Fixation
Mean						
Median						
Mode						
Variance						
...						

b. Produce histograms and Q-Q plots for each one of the 6 groups and interpret each plot (i.e. what does the plot suggest about the distribution).
c. Test whether the variables are normally distributed. Report the results of your normality tests in a table. Given the descriptives and the results of the normality tests, which central tendency measure will be most appropriate to summarize task completion time values in each puzzle and condition combination?
d. Are there any outliers? Which outlier detection method should be used given the descriptive statistics on task completion time. Use the appropriate outlier detection approach to state potential outliers (if any).
e. Apply a logarithmic transformation to task completion time values and answer parts b and c for the transformed variable.

Question 3. (20 pts) Descriptives for response:
a. Report the measures of central tendency (mean, median, mode) and dispersion (variance, SD, SE, skew, kurtosis) for response values for each puzzle type and condition in a table.
b. Produce histograms and Q-Q plots for each one of the 6 groups and interpret each plot (i.e. what does the plot suggest about the distribution).
c. Test whether the variables are normally distributed. Report the results of your normality tests in a table. Given the descriptives and the results of the normality tests, which central tendency measure will be most appropriate to summarize response values in each puzzle and condition combination?
d. Are there any outliers? Which outlier detection method should be used given the descriptive statistics on response values. Use the appropriate outlier detection approach to state potential outliers (if any).

Question 4. (10 pts) Plot two clustered box plots for a. task completion time b. response variables. An example that illustrates the desired format for the boxplot is shown in the figure below. In your plot you should have conditions on the x-axis and RP/TOH should be distinguished with separate colors. The y-axis should include task completion time for the first boxplot, and response for the second boxplot.

Question 5. (20 pts) Try to interpret the boxplots you prepared in Q4. What information is communicated by these boxplots (i.e. what do the bars, boxes and whiskers mean)? How do the completion time and response values change across puzzle types and task conditions? What do you think might be the reason underlying the similarities or differences you observe across puzzle types and task conditions?

Assignment-2

Q.1: Basic Design
State the design of the study (e.g. cross-sectional, experimental, correlational - check the categories mentioned in chapter 1). State your reasoning. On what scale are these variables measured (nominal, ordinal, interval, ratio) and why?

Q.2: Descriptives and Test of Normality
Generate two tables that summarize the basic descriptives and tests of normality. The first table should summarize the measures of central tendency (mean, median, mode) and dispersion (variance, SD, SE, skew, kurtosis) for IQ, VerbalIQ, PerformanceIQ, MRI_volume, height and weight. The second table should show the results of normality tests. Add a short paragraph stating which variables are normally distributed by using the reporting format suggested in the textbook.

Q.3: Correlation
Produce a correlation matrix including entries for IQ, Verbal_IQ, Performance_IQ, MRI_Volume, height and weight.
a. Describe the relationship among these variables in terms of the correlation coefficients you have computed. How much of the variability is shared by each pair of variables?
b.What is the correlation between MRI_Volume and Verbal_IQ when the effect of Performance_IQ on both variables are controlled? Try to interpret the pattern of covariation among MRI_Volume and Verbal_IQ by comparing the regular and partial correlation values (i.e. what do these results tell you about the relationship between MRI_Volume and Verbal_IQ)?
c.What is the correlation between MRI_Volume and Weight when the effect of IQ on both variables are controlled? Try to interpret the pattern of covariation among MRI_Volume and Weight by comparing the regular and partial correlation values (i.e. what do these results tell you about the relationship between MRI_Volume and Weight)?

Q.4: Regression
Produce a scatterplot of IQ and MRI_Volume by using the Chart Builder where data points for females and males are marked separately. Edit the chart to draw the regression line. Run a linear regression to obtain a model summary including MRI_Volume as the predictor of IQ.

a. How much of the variance observed in IQ can be explained by this model?
b. Is the model a good fit as compared to the baseline mean model?
c. What is the regression equation?
d. What is the predicted value of the IQ of a person if his brain volume is 924059? What is the residual?
e. Add regression lines for females and males, and compare the two groups in terms of the parameters of their respective regression lines.
f. Build a multiple regression model with IQ as the outcome variable and MRI_Volume and gender as predictors. What's the regression equation? Is this model better than the model that had MRI_Volume as the only predictor? Are MRI_volume and gender significant predictors? Which variable is the stronger predictor and why?
g. Build a multiple regression model with Verbal_IQ as the outcome and MRI_Volume and gender as predictors. What's the regression equation? Are MRI_volume and gender significant predictors? Which variable is the stronger predictor and why?
h. Provide a general interpretation of the relationships between these variables based on your regression analysis for previous questions.

Assignment-3

A researcher has asked a sample of voters in a country to rate their support for the current government (status quo), their educational level, age, gender, annual income, and whether they will vote Yes or No in an upcoming referendum. 1757 of the interviewees agreed to declare their vote. The dataset is provided in Voting.sav file.

Conduct a logistic regression analysis on this data to see which factors might be useful for predicting voting behavior in this country. In particular, construct separate models where:

i) age is the only predictor
ii) government support is the only predictor
iii) a model including all variables with Backward:Wald as the data entry method.

For each model answer the following questions by first providing a copy of the relevant table from the SPSS output:

a. Is this model a significant fit to the data? Why or why not?
b. What's the equation for the model?
c. How does the prediction power of the model compare to the baseline model?
d. Is/are the predictor variable(s) making a significant contribution to the prediction of the outcome? Why or why not?
e. What is the odds ratio value in this model? What does it tell you about the model (i.e. provide a verbal description of what it implies about the data)?
f. Does the confidence interval of a predictor in the model include the value 1? What would be the issue if the confidence interval includes 1?
g. Are the residuals normally distributed? Are there any influential cases? What do these tests imply about the predictive power of the model?
h. For the model in iii, are there any signs of multicollinearity among predictors in the resulting model? Why this is not a problem for models i and ii?
i. For the model in iii, which variables are removed at each iteration step and why?

Assignment-4

A study of reading comprehension in children compared three methods of instruction. First, all participants' reading comprehension levels were assessed with a pre-test. Then, participants were split into 3 groups, where they were exposed different methods of instruction to develop their reading comprehension skills. Finally, all group members were given a post-test that is comparable to the pre-test in terms of content. The data for the study is stored in reading.sav file.

1. Identify the dependent and independent variables of this study. At what level of scale each variable is measured?

2. Are the dependent variables normally distributed? Do they satisfy homogeneity of variance? Perform the appropriate tests in SPSS and report their results (Note: use the appropriate group level for these tests. You should keep in mind the comparisons you will do in the next questions)

3. Focus on the pre-test results only. Draw a bar chart with 95% confidence intervals. Is there a difference among the groups? Which test would be appropriate to test whether there is a statistically significant difference among the groups and why? What is the null hypothesis? Do the test and report the test results (you should use the reporting guidelines in the book). If there is an overall difference, which pair of groups differ from each other? Again, explain what statistical test you are using to make that argument.

4. Next, focus on the post-test results. Draw a bar chart with 95% confidence intervals. Is there a difference among the groups? Which test would be appropriate to test whether there is a statistically significant difference among the groups and why? What is the null hypothesis? Do the test and report the test results (you should use the reporting guidelines in the book). If there is an overall difference, which pair of groups differ from each other? Again, explain what statistical test you are using to make that argument.

5. Finally, focus on each instruction group separately. Which test should you use to compare the difference between the pre and post test scores of each student in each instruction group? Do the appropriate test(s) and report the results in the formal reporting format.

6. Provide a paragraph summarizing the overall results of the study given what you have found in 3,4,5. What does this data tell us regarding which instructional method was the most effective for developing children's reading comprehension skills?

Assignment-5

People diagnosed with obsessive compulsive disorder (OCD) exhibit behavioral anomalies such as checking whether they have locked the door before they leave their house excessively. Regular people also exhibit such behaviors from time to time, but OCD patients do them in such an excessive way that they may spend an hour checking the locks, windows etc. before they can finally leave their home. A candidate theory that aims to explain such excessive behavior among OCD sufferers suggests that such patterns may be caused by a combination of the persons' mood (i.e. positive or negative) and the rule they employ for deciding when to halt a task (e.g. continue until you feel like you want to stop or continue until you have done the task as best as you can). A researcher puts this theory into test by administering an experiment. The researcher induced a positive, neutral or negative mood on people by asking participants to listen to certain samples of music and by adjusting the amount of light in the room. Then the researcher asked the participants to imagine that they were about to leave their home for a vacation and they should generate a list of items that

they would absolutely check before they leave. In each mood group, half of the participants were asked to generate as many items as they can, whereas the other half was instructed to continue until they think their list is complete. In each condition participants produced the following number of items in their lists:

Negative mood, as many as you can: 7, 5, 16, 13, 13, 24, 20, 10, 11, 7
Negative mood, feel like continuing: 3, 8, 8, 5, 9, 14, 9, 15, 7, 14
Positive mood, as many as you can: 9, 12, 7, 3, 10, 4, 5, 4, 7, 9
Positive mood, feel like continuing: 13, 31, 11, 8, 11, 25, 19, 8, 14, 8
Neutral, as many as you can: 8, 5, 11, 9, 11, 10, 11, 10, 7, 5
Neutral, feel like continuing: 7, 5, 14, 19, 5, 11, 14, 10, 6, 8

Enter this data to spss in the appropriate way and conduct the appropriate ANOVA to answer the questions below:

a. Identify the independent and dependent variables included in this study.

b. The design employed in this study can be characterized as _____ (one/two/three) way _____ (factorial/repeated measures/mixed) ANOVA (fill in the blanks by choosing the correct term, and state your reasoning).

c. Check whether this data set satisfies the parametric assumptions of ANOVA.

d. Draw a hierarchical tree diagram that shows the fractionation of the corrected total sum of squares into model and residual terms (see p.361, 425 or 463 in Field, 3rd ed for example diagrams). Name the boxes in your diagram appropriately and place the corresponding sum of squares in each box. (Don't calculate the sum of squares by hand, just use the relevant cells in the spss output).

e. Is there a significant main effect of mood and stop_rule? Is there a significant interaction effect of mood and stop_rule? What are the effect sizes? Also report the results of post-hoc tests for the significant cases.

f. Produce mean plots and bar charts to support your analysis (with confidence intervals).

g. Interpret the findings of the experiment to see if the data supports the theory outlined in the description. What hypotheses can be formulated and tested with this data? Does your analysis support/reject those hypotheses? State your findings in the standard report format.

Assignment-6

A researcher who is interested in the effects of rhythmic auditory intervention on sensory-motor coordination administers an experiment where subjects are asked to complete the rotary pursuit task . In this task the goal is to pursue the rotating circle with the mouse cursor. 18 randomly selected participants perform the task under three conditions. In condition 1 there is no auditory stimulation. In the other two conditions the subject hears a periodic clicking sound. In condition 2, the click occurs twice per second, whereas in

condition 3 the click occurs six times per second. In all conditions the circle rotates at the same speed (1 rotation per second) in the clockwise direction. The experimenter counterbalanced the order of the conditions. The following data is collected:

Subject 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

Condition 1 35 32 33 32 31 29 29 27 27 28 27 27 24 24 17 17 14 13

Condition 2 39 35 32 32 33 30 31 29 31 27 27 26 29 25 16 15 15 13

Condition 3 32 31 28 29 26 29 27 27 24 24 23 23 19 19 18 17 12 13

a. Enter this data set into spss in the appropriate format. Organize the data based on the description of the experiment given above.

b. Identify the independent and dependent variables included in this study.

c. The design employed in this study can be characterized as ____one_____ (one/two/three) way ____repeated measures_____ (factorial/repeated measures/mixed) ANOVA (fill in the blanks by choosing the correct term, and state your reasoning).

d. In the description we are told that the experimenter counterbalanced the order of the conditions. What does this mean? Why is it important? How many different orders are possible in this experiment? If you were the experimenter how would you do the counterbalancing?

e. Check whether this data set satisfies the parametric assumptions of the relevant ANOVA test.

f. Perform the appropriate ANOVA. Draw a hierarchical tree diagram that shows the fractionation of the corrected total sum of squares into model and residual terms. Name the boxes in your diagram appropriately and place the corresponding sum of squares in each box. (Don't calculate the sum of squares by hand, just use the relevant cells in the spss output).

g. Is there a significant effect of the experimental manipulation? What is the effect size? If you find a main effect, also report the results of the post-hoc tests. Report your findings in the standard reporting format as described in the textbook.

h. Suppose that the data is not suitable for ANOVA analysis. What would be the appropriate non-parametric test? Perform the test in SPSS and report your findings in the standard reporting format. Also report the results of the non-parametric post hoc tests (with the appropriate adjustment to the alpha=0.05 level).

i. Produce mean plots and bar charts to support your analysis (with confidence intervals).

j. Interpret the findings of the experiment by summarizing your test results. What hypothesis is tested with this data? Does your analysis support/reject this hypothesis? State your findings in the standard report format.

Assignment-7

A researcher is interested in identifying how psychology majors' knowledge of different aspects of psychology improved throughout the first three years of their undergraduate education. The experimenter took a sample of first, second and third year students and gave them five multiple choice tests (maximum possible score was 15 for each test) representing

core areas in psychology: Statistics, Experimental Psychology, Social Psychology, Developmental Psychology and Psychiatry. The dataset for this study is in PsychUndergrads.sav

a. What are the independent/dependent variables in this study?
b. Check whether parametric assumptions for MANOVA are met by this dataset.
c. What can you conclude from the Multivariate Tests table? Is there an experimental effect? (Provide the test results table, state which test you picked and why)
d. Also conduct individual ANOVA test(s) for the dependent variable(s). What can you deduce from individual ANOVA tests regarding the differences among student groups across topics? Given the results for each dependent variable, does it make sense to conduct contrasts or post-hoc tests? If so, report the results of follow up tests.
e. What does the Wilk's lambda output tell you? How many variates would you need to discriminate the student groups?
f. Plot the territorial map and the combined/separate group maps. How would you interpret the discriminating role of each function (i.e. underlying variate(s)) based on the way group centroids are located by the discriminant analysis procedure?
g. Provide an overall summary of the findings of this MANOVA analysis in the formal reporting format as suggested in the textbook.
h. Name two advantages of MANOVA over conducting multiple individual ANOVAs.

APPENDIX B: RESULTS OF TEAM2 AND TEAM5

RESULTS OF TEAM2

Segments and Matching Questions

Ass. 1												
Segment	S2	S3	S5	S7	S8	S10	S11	S12	S14	S15		
Question	A	B	c	C	c	d			b	c		
Ass. 2												
Segment	S2	S3	S4	S5								
Question	1		1	2								
Ass. 3												
Segment	S2	S3	S4	S5	S6	S9	S10	S12	S13	S14	S15	
Question	A	b	c	d	d	e	f	g	g	h		
Ass. 4												
Segment	S2	S3	S4	S5								
Question	1		2	2								
Ass. 5												
Segment	S3	S5										
Question	A	b										
Ass. 6												
Segment												
Question												
Ass. 7	S2	S4	S5	S6	S7	S8	S9					
Segment	A	b	b	c	c	d	e					
Question												

Learners' Conceptual Development in Chat Environment and Reflections of Chat Discussions to Wiki Output

VARIABLES CONCEPT

ASSIGNMENT-1

Dependent and Independent Variables

The group started to discuss about types of variables with the notification provided by H_A (line 81). That is, he stated that they had no prior conversation about dependent and independent variables (line 81, 82). Z_B shared the same idea with H_A, hence offered to provide explanations for that question (line 83). By considering the problem statement, H_A indicated that the number of towers affects the number of steps (line 85-87).Therefore, he categorized the number of towers as independent (line 88), and the number of steps as dependent variable (line 89). Then, in order to show the relation between these two variables, he provided a formula based on their solution for the previous problem (line 90-92). However, Z_B thought that the solution provided by H_A addressed to the tower of Hanoi (TOH) puzzle instead of the question relating to types of variables (line 93, 94). Thus, Z_B

offered to consider puzzles and three conditions (picture, blank and fixation) as variables of the question (line 97). On the other hand, H_A couldn't receive the actual idea and understood that Z_B had implied the missing solution for the second puzzle. Hence, he stated that they solved the first question for the TOH puzzle (line 96) and did nothing for the river problem (line 98).

Line	Date	Post Time	Chat Message / Whiteboard Activity
81	11/5/2013	12:03 PM	H_A: we did say anything about the dependent independent variables
82	11/5/2013	12:03 PM	H_A: did not*
83	11/5/2013	12:03 PM	Z_B: ok, why not we explain it literally as you said
84	11/5/2013	12:04 PM	H_A: yes
85	11/5/2013	12:04 PM	H_A: the problem is defined with a variable
86	11/5/2013	12:04 PM	H_A: the number of towers
87	11/5/2013	12:04 PM	H_A: the number of towers affects the number of the steps
88	11/5/2013	12:05 PM	H_A: therefore the number of towers is an independent variable in this experiment
89	11/5/2013	12:05 PM	H_A: and the steps count is dependent to that as below
90	11/5/2013	12:05 PM	H_A: y=2^n-1
91	11/5/2013	12:05 PM	H_A: y is steps count
92	11/5/2013	12:05 PM	H_A: n is number of towers
93	11/5/2013	12:06 PM	Z_B: for the tower of Hanoi is puzzle, I agree
94	11/5/2013	12:06 PM	Z_B: but if you are answering the question c
95	11/5/2013	12:07 PM	H_A: yes
96	11/5/2013	12:07 PM	H_A: i think we did a,b,c for TOH
97	11/5/2013	12:07 PM	Z_B: I think we need to think about the puzzles and the three conditions given (picture, blank and fixation)
98	11/5/2013	12:08 PM	H_A: yes but we did nothing about river problem

Analysis of the messages between lines 81 and 98 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. In the initial messages, H_A indicated their lack of study towards identifying dependent and independent variables, which represent a trigger activity that expects solutions of members. Between messages in lines 85 and 92, H_A proposed the solution that number of towers as dependent and steps count as independent variable. Hence, these offers represent the *idea generation* phase. In the next message in line 93, Z_B indicated her agreement to the offers if they consider TOH puzzle. Then, she suggested to consider puzzles and conditions if they are solving the question c.

Question

H_A misunderstood the explanations in the question and considered number of towers and number of steps as variables. Hence, he categorized these variables according to the measurement scales between chat lines 101 and 128. However, Z_B had correct understanding and indicated that H_A's explanations were appropriate if TOH puzzle was considered as the experiment. She offered that they should consider the puzzle in part a, and

consider the whole experiment in the other parts (line 129). However, H_A didn't provide any confirmation to the suggestion of Z_B. This is because he thought that statements in the part a also cover part b, c, and d (line 130-132). Similarly, M_G offered to consider puzzles while solving all parts of the question 1 (line 133). Z_B insisted on her understanding of the problem and provided detailed explanation between chat lines 137 and 141. She initially shared the explanation of the problem - "Each participant was informed about the rules of the puzzle and then randomly assigned to one of the puzzle groups, and then to one of the picture, blank and fixation conditions"(line 137). And, she asked how they explained the conditions variable (line 139) in order to indicate its extinction in the solution. Then, she explained purposes of the parts of the question 1. According to her thought, the part a is for checking steps of puzzles and the remaining parts are related to the whole experiment (line 140). As a result, H_A understood his misunderstanding and indicated his agreement to the offers of Z_B (line 143, 144). After they gained a common understanding, they decided to resolve the question (line 149).

Line	Date	Post Time	Chat Message / Whiteboard Activity
129	11/5/2013	12:24 PM	Z_B: ok, you are right if we consider the towers of hanoi as the experiment itself, but I think I misunderstood the questions, could you please clarify? I think the experiment/study is something different. the puzzle is only one part and we should answer the items b,c,d not for each problems/puzzles but the whole experiment :(or am I wrong?
130	11/5/2013	12:24 PM	H_A: 1.a says that do this steps for both
131	11/5/2013	12:24 PM	H_A: and i think it is not stated in 1.b,1.c,1.d
132	11/5/2013	12:24 PM	H_A: because 1.a spans for all
133	11/5/2013	12:25 PM	M_G: i think we must answer all parts separately for river and tower
134	11/5/2013	12:25 PM	H_A: yes, agree
135	11/5/2013	12:25 PM	Z_B: I am not sure, I am sorry. If we read the description of the study on the first page, I understood it this way.
136	11/5/2013	12:26 PM	M_G: after finishing part d for tower, it is turn to answer the river
137	11/5/2013	12:26 PM	Z_B: "Each participant was informed about the rules of the puzzle and then randomly assigned to one of the puzzle groups, and then to one of the picture, blank and fixation conditions."
138	11/5/2013	12:26 PM	Z_B: it explains the study like this
139	11/5/2013	12:27 PM	Z_B: and how do you explain the three conditions given, then?
140	11/5/2013	12:30 PM	Z_B: I think 1.a is just to see how we would solve the problems/puzzles or what would be the correct steps to solve, so that we can understand the participants' performance better, maybe. However, the rest (b,c,d) is related to the whole experiment. Maybe I am wrong, but this is how I understood the questions..
141	11/5/2013	12:36 PM	Z_B: yes, see topic tab, the very first sentence, ?think we don't need to explain each one of the puzzles separately, they are just questions given to the participants.
143	11/5/2013	12:40 PM	H_A: ok you are right
144	11/5/2013	12:40 PM	H_A: we did wrong :)
145	11/5/2013	12:41 PM	M_G: :)))

146	11/5/2013	12:41 PM	Z_B: no, ? understand the presence of two puzzles in one experiment was a little bit confusing
147	11/5/2013	12:41 PM	Z_B: :)
148	11/5/2013	12:41 PM	H_A: :)
149	11/5/2013	12:41 PM	Z_B: ok lets start again then

The messages between lines 129 and 149 can be analyzed based on the Progressive Knowledge Building Inquiry cycle as follows. In these messages, Z_B provided her understanding of the question and indicated her disagreement to the previous understanding of the team. This was considered in *idea connection* phase since it consisted of comparison between her and the team's understanding. In addition, she offered the actual explanation of the question, which demonstrates the activity in *idea generation* phase. After the explanations, other members indicated their agreement to the idea of Z_B.

Dependent and Independent Variables

For the solution of the question 1c, H_A stated that conditions affect the time consuming for the problem solving (line 156). At the same time, H_A indicated his sadness about his late understanding (line 157). Z_B explained that one purpose of the group work is correcting such cases. Then, Z_B confirmed the solutions (line 158) and provided categorizations for the variables. She offered conditions as independent and time consuming as dependent variable. At the end, H_A indicated his agreement to the offer of Z_B (line 163). The final solution demonstrated that the team correctly identified dependent and independent variables.

Line	Date	Post Time	Chat Message / Whiteboard Activity
154	11/5/2013	12:42 PM	H_A: i can say somethings for 1.c
155	11/5/2013	12:42 PM	Z_B : ok
156	11/5/2013	12:43 PM	H_A: picture blank and conditions affects the time consuming for the problem solving
157	11/5/2013	12:43 PM	H_A: i understood lately sorry :)
158	11/5/2013	12:43 PM	Z_B : exactly
159	11/5/2013	12:44 PM	Z_ B: nope, that's fine, that's why we are doing it as a group :)
160	11/5/2013	12:44 PM	Z_ B: so we can say
161	11/5/2013	12:44 PM	Z_ B: these three conditions are independent variables
162	11/5/2013	12:44 PM	Z_ B: and time consuming for problem solving dependent
163	11/5/2013	12:44 PM	H_A: yes exactly

In terms of Progressive Knowledge Building Inquiry cycle, the messages between lines 154 and 163 can be analyzed as follows. In the message in line 156, H_A explained his understanding of the question c that "conditions affect the time consuming for the problem solving", which represents the *idea generation* phase. Z_B accepted this idea and offered that conditions as independent, time consuming as dependent variables between lines 160 and 162. These messages can be considered in *idea connection* phase since they consist of comparison and agreements.

Wiki Reflection

The group wrote the following output as the wiki content. "Dependent Variables: Task Completion Time and Responses. Independent Variables: Three Conditions (Picture, Blank, Fixation)". The wiki output reflects majority of the content related to the group's final decisions in the chat environment. The group already identified conditions as independent variable and time consuming as dependent variable. The only difference is that responses were also categorized as another dependent variable.

ASSIGNMENT-2

Scales of Variables

Z_B initiated the discussion by naming the variables as gender, weight, height, brain volume, intelligence (IQ scores) in the study (line 71). H_A accepted the offer of Z_B (line 72). Z_B categorized the gender as binary by proposing the reason as existence of two categories within this variable (line 73). Then, she categorized weight and height in ratio scales (line 75), and intelligence and brain volume in ordinal scales (line 76).However, H_A offered that weight and height variables are in interval scale (line 77). Z_B asked the reason of this suggestion (line 79).H_A responded that in interval scale there is a difference (line 80). Then, he continued to suggest that height is not interval since one cannot say the height is double of someone (line 82-85). Z_B explained the existence of true zero in ratio as the difference between ratio and interval, then concluded weight and height as ratio variables (line 86). H_A suggested that the ratios of scores on the scale must also make sense, and provided the anxiety score as the example ratio variable (line 87).

Line	Date	Post Time	Chat Message / Whiteboard Activity
71	11/17/2013	3:32 PM	Z_ B: So the variables are gender, weight, height, brain volume, intelligence(IQ scores)
72	11/17/2013	3:33 PM	H_A: ok
73	11/17/2013	3:33 PM	Z_B: Gender is binary, I think because there are only two categories.
74	11/17/2013	3:33 PM	H_A: yes
75	11/17/2013	3:34 PM	Z_B: Weight and height are ratio.
76	11/17/2013	3:37 PM	Z_B: as regards intelligence and brain volume, I think they are ordinal.
77	11/17/2013	3:37 PM	H_A: i think they are interval
78	11/17/2013	3:37 PM	H_A: ratio means you can find a ratio
79	11/17/2013	3:37 PM	Z_B: why do you think so?
80	11/17/2013	3:37 PM	H_A: interval means you can find a difference
81	11/17/2013	3:37 PM	Z_B: but there is a true zero.
82	11/17/2013	3:38 PM	H_A: you never say the height is double of some one
83	11/17/2013	3:38 PM	H_A: but you can say you are 10 cm taller
84	11/17/2013	3:38 PM	H_A: may weight is a ratio
85	11/17/2013	3:38 PM	H_A: but height is not

86	11/17/2013	3:40 PM	Z_B: Well, there are many common points between interval and ratio but the difference is that there is a true zero in ratio, and weight and height are counted as the examples of ratio variable.
87	11/17/2013	3:39 PM	H_A: Ratio variable: The same as an interval variable, but the ratios of scores on the scale must also make sense e.g. a score of 16 on an anxiety scale means that the person is, in reality, twice as anxious as someone scoring 8

Analysis of the messages between lines 71 and 87 based on the Progressive Knowledge Building Inquiry cycle results in following interpretations. In the first message, Z_B listed the variables as gender, weight, height, brain volume, intelligence(IQ scores). In the message in line 73, she categorized the gender in binary scale which is considered in *idea generation* phase. This offer was accepted by H_A in the message in line 74. In the message in line 75, Z_B offered that weight and height are ratio variables, which demonstrate the *idea generation* phase. On the other hand, H_A offered that weight and height variables are in interval scale (line 77) and indicated that in interval scale there should be difference (line 80). H_A continued to suggest that height is not in interval scale since one cannot say the height is double of someone (line 82-85). Offers of H_A are considered in *idea generation* phase. Z_B suggested the existence of true zero in ratio as the difference between ratio and interval, then concluded weight and height as ratio variables (line 86). H_A suggested that the ratios of scores on the scale must also make sense, and provided the anxiety score as the example ratio variable (line 87).

Z_B shared a link of a web site that explains scales of variables (line 88) and again mentioned the true zero as the differentiating factor between ratio and interval (line 90). However, H_A understood that existence of true zero makes the variable as continuous instead of interval (line 92-94). Then, he offered that there is no true zero value for weight and height variables (line 95). According to H_A, the ratio scale requires existence of values in interval (line 98). Moreover, he offered that in ratio variable, they may change the height into another metric which has a zero in it and the zero has to match the old one (line 101). Z_B provided a correct statement that in interval scale the difference between the units must be the same (line 102). H_A offered to change the height to another metric that consists of zero value (line 103). He offered that they can convert 110 cm to -50 apt (line 105) which is an unknown metric (line 107). He stated that 0 apt becomes 60 cm (line 108) but 0 apt indicates nothing from the perspective of height value (line 109). His reasoning is that there is no zero height for human being (line 111). After this explanation, Z_B stated that 0 means there is nothing in weight and height. Then, she asked the idea of H_A if 0 celcius means no hot or cold weather (line 112). As a response, H_A provided confirmation for the existence of 0 in temperature case (line 114). Z_B explained that the temperature is in interval scale since there is a true zero (line 117-119) and stated that existence of true zero makes the value in ratio scale (line 120-123).

Line	**Date**	**Post Time**	**Chat Message / Whiteboard Activity**
88	11/17/2013	3:42 PM	Z_B: remember the link that you sent for the previous work. http://www.graphpad.com/support/faqid/1089/
89	11/17/2013	3:42 PM	Z_B: it is also written here.

90	11/17/2013	3:42 PM	Z_B: I mean you are right, they are quite similar, but we can distinguish them thanks to this true zero thing.
91	11/17/2013	3:43 PM	Z_B: I think :)
92	11/17/2013	3:43 PM	H_A: yes i looked at the true 0 condition
93	11/17/2013	3:44 PM	H_A: if there is a zero it means it is continuous
94	11/17/2013	3:44 PM	H_A: not interval
95	11/17/2013	3:44 PM	H_A: there is no zero value for weight and height for human being
96	11/17/2013	3:44 PM	Z_B: interval is also continuous.
97	11/17/2013	3:44 PM	H_A: when weight is 0 it is nonsense
98	11/17/2013	3:45 PM	H_A: to be a ratio, you have to make the values on any interval :)
99	11/17/2013	3:45 PM	H_A: interval has only one interval as it is
100	11/17/2013	3:45 PM	H_A: this is the difference i understand
101	11/17/2013	3:46 PM	H_A: if it is ratio we may change the height into another metric which has a zero in it and the zero has to match the old one
102	11/17/2013	3:47 PM	Z_B: In interval scale the difference between the units must be the same, right such as temperature, you cannot say that something has no temperature.
103	11/17/2013	3:47 PM	H_A: lets change height to another metric which has a zero value in it
104	11/17/2013	3:48 PM	H_A: the definition fits for height :)
105	11/17/2013	3:48 PM	H_A: for height, lets make 110 cm map to -50 apt
106	11/17/2013	3:49 PM	Z_B: but you can start from 0 and say 110 cm. If something is 0 in terms of height. It means it does not exist :) . In temperature 0 does not mean that there is no temperature.
107	11/17/2013	3:49 PM	H_A: apt is some unknown metric
108	11/17/2013	3:49 PM	H_A: them 0 apt is 60 cm
109	11/17/2013	3:49 PM	H_A: but 0 apt is nonsense for height
110	11/17/2013	3:49 PM	H_A: it is same for weight
111	11/17/2013	3:50 PM	H_A: but there is no zero height human being
112	11/17/2013	3:51 PM	Z_B: ok but there is this concept, I mean 0 means there is nothing in weight and height. but think about the winter, the weather is 0 celcius, does it mean there is no hot or cold weather :)
113	11/17/2013	3:51 PM	H_A: there is no zero height for human being :)
114	11/17/2013	3:51 PM	H_A: yes it is true for temperature
115	11/17/2013	3:51 PM	Z_B: think about exam
116	11/17/2013	3:51 PM	Z_B: scores
117	11/17/2013	3:52 PM	Z_B: yes because we don’t have a true zero
118	11/17/2013	3:52 PM	Z_B: in temperature
119	11/17/2013	3:52 PM	Z_B: it is interval
120	11/17/2013	3:52 PM	Z_B: when we have a true zero
121	11/17/2013	3:52 PM	Z_B: which mean "there is nothing"

122	11/17/2013	3:52 PM	Z_B: then it is ratio
123	11/17/2013	3:52 PM	Z_B: that's what I understood

Analysis of the messages between lines 88 and 123 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. In the initial message, Z_B shared the link of a web source that explains the difference between ratio and interval. Then, she indicated that the true zero is evidence of the difference in line 90, which illustrated the *idea generation* phase. Yet, H_A indicated that existence of true zero makes the variable as continuous (line 92-94). In addition, he proposed that there is no true zero value for weight and height variables (line 95). According to H_A, the ratio scale requires existence of values in interval scale (line 98). His offers can be considered in *idea generation* phase. Z_B indicated that the difference between the units must be the same in interval scale (line 102). H_A suggested transforming the height to another metric that consists of zero value (line 103). This offer can be considered as *idea improvement* since consists of further example. His interpretation is that there is no zero height for human being, which is considered in *idea generation* phase (line 111). Z_B stated that 0 means there is nothing in weight and height. Then, she asked if 0 celcius refers lack of hot or cold weather (line 112). H_A provided confirmation for the existence of 0 in temperature case (line 114). Z_B offered that the temperature is in interval scale since there is a true zero (line 117-119) and stated that existence of true zero makes the value in ratio scale (line 120-123). Explanations and reasonings of Z_B illustrate the *idea improvement* phase.

M_G thought that -273 celcius is the true zero value for the temperature (line 124, 125). Yet, Z_B provided the correct definition of the true zero by stating its meaning that "there is nothing' (line 127). Similarly, H_A informed M_G that the true zero doesn't refer extinction of temperature(line 129). Then, M_G understood and confirmed the offers of other members (line 131, 132).

H_A stated his confusion about the scale of the height variable (line 130). According to Z_B, H_A's confusion originated from the reality that there is no human being with 0 cm (line 134). Therefore, Z_B tried to explain the identification of one's height by stating that they start from 0 until that value (line 135). After this explanation, H_A concluded that the height is in interval scale in the experiment provided in the question (line 137). Similarly, M_G offered that weight and height are in interval scale based on a related online source (line 138).

M_G proposed that the temperature is in ratio scale (line 141). But, H_A explained that it is not ratio since there is no true zero for it (line 143, 144). After this statement, Z_B reminded the existence of true zero for height and weight variables and offered them in ratio scale (line 145, 146). H_A couldn't become sure enough and offered to continue with categorizing other variables in the question (line 148, 149).

Line	Date	Post Time	Chat Message / Whiteboard Activity
124	11/17/2013	3:52 PM	M_G: in temperature we have true zero
125	11/17/2013	3:52 PM	M_G: -273 celcius
126	11/17/2013	3:53 PM	M_G: :)
127	11/17/2013	3:53 PM	Z_B: ok but true zero mean "there is nothing"
128	11/17/2013	3:53 PM	M_G: exact zero ;)
129	11/17/2013	3:53 PM	H_A: M_G, it does not mean there is no temperature, zeynep is right
130	11/17/2013	3:53 PM	H_A: but i am confused height in this experiment
131	11/17/2013	3:53 PM	M_G: ye i understand what Z_B said
132	11/17/2013	3:54 PM	M_G: i agree with her
133	11/17/2013	3:54 PM	Z_B: yes I understand H_A
134	11/17/2013	3:54 PM	Z_B: you are confused because there is no human being with 0 cm
135	11/17/2013	3:54 PM	Z_B: but we start from 0 and say if one is 150 cm or something
136	11/17/2013	3:54 PM	H_A: yes
137	11/17/2013	3:54 PM	H_A: therefore it is interval in this experiment
138	11/17/2013	3:54 PM	M_G: according to that link, weight and height are interval
139	11/17/2013	3:54 PM	H_A: may be it is not in another experiment
140	11/17/2013	3:54 PM	H_A: but in this one, it is interval
141	11/17/2013	3:55 PM	M_G: and temperature is ratio
142	11/17/2013	3:55 PM	Z_B: can we say this?
143	11/17/2013	3:55 PM	H_A: there is no true zero for temperature
144	11/17/2013	3:55 PM	H_A: it is not ratio
145	11/17/2013	3:55 PM	Z_B: yes
146	11/17/2013	3:56 PM	Z_B: but there is true zero for height and weight
147	11/17/2013	3:56 PM	Z_B: because the participants exist, we cannot say they are not ratio here :)
148	11/17/2013	3:56 PM	H_A: ok we may say that

In terms of the Progressive Knowledge Building Inquiry cycle, messages between lines 124 and 148 can be analyzed as follows. In these messages, members generally provided their ideas about the scales of weight and height. Therefore these messages were categorized in *idea generation* phase.

Z_B asked the scales of intelligence and brain volume (line 150). As a response, H_A offered the volume in ratio (line 151) and intelligence in interval scale (line 152). On the other hand, Z_B offered them as ordinal variables by stating the meaningful comparison for their scores (line 154, 155). In addition, she stated that there is not a true zero (line 157) and equal intervals don't address to equal differences (line 158). H_A provided confirmation for the suggestions of Z_B (line 159, 160).

Line	Date	Post Time	Chat Message / Whiteboard Activity
149	11/17/2013	3:57 PM	H_A: lets goon
150	11/17/2013	3:57 PM	Z_B: intelligence and brain volume?
151	11/17/2013	3:58 PM	H_A: volume is ratio
152	11/17/2013	3:58 PM	H_A: intelligence is interval
153	11/17/2013	3:58 PM	H_A: i guess
154	11/17/2013	3:58 PM	Z_B: I thought they are ordinal.
155	11/17/2013	3:59 PM	Z_B: because all scores are meaningful for comparison only
156	11/17/2013	3:58 PM	H_A: hmm
157	11/17/2013	3:59 PM	Z_B: there is not a true zero
158	11/17/2013	3:59 PM	Z_B: and equal intervals don't represent equal differences
159	11/17/2013	3:59 PM	H_A: yes you are right
160	11/17/2013	3:59 PM	H_A: i agreed

In terms of Progressive Knowledge Building Inquiry cycle, the messages between lines 149 and 160 were detected to exist in two phases: idea generation and idea connection. In messages between lines 151 and 153, H_A offered that volume is ratio and intelligence is interval scale, hence they are considered in the phase of *idea generation*. On the other hand, Z_B offered that they are in ordinal scale and provided reasons in messages 154, 155, 157, and 158. These messages can be considered in *idea connection* phase, since there is comparison and disagreement.

Wiki Reflection

The group categorized the gender as binary in the chat environment, which is also reflected to wiki content in the same way together with the rationale that there are two categories. This categorization was correctly conducted by the group.

In the chat environment, the group performed a long discussion related to scales of weight and height variables. The wiki output demonstrates that they finally properly identified these variables in ratio scale. In addition, for each variable, they provided an appropriate interpretation –"There is a true zero point on the scale. The ratios of the values are meaningful."

As they discussed in the chat environment, they identified the brain volume and intelligence in ordinal scales. In addition, they provided rationale for the scales of these variables as follows: All scores are meaningful for comparison only. There is not a true zero and equal intervals don't represent equal differences in the property being measured. On the other hand, their solution and interpretation was not appropriate. Brain volume is in ratio scale because of existence of ratios along the scales, and occurrence of a true and meaningful zero. In addition, intelligence variable should be categorized in interval scale. This is because it consists of equal intervals but not ratios along the scales.

Assignment-4

Dependent and Independent Variables

Z_B initiated the discussion by asking dependent and independent variables in the study (line 77). M_G offered the pre test and post test as dependent variables (line 78). However, Z_B thought that reading comprehension as dependent and three methods as independent variables (line 79). H_A agreed that methods are independent but not sure if the reading comprehension is dependent (line 80). According to his idea, they need to consider pretest and posttest results as dependent variables (line 81). In addition, he thought that they can ignore reading comprehension since it becomes observable by the help of test scores (line 82, 83). With this explanation, Z_B was persuaded that they need to consider pretest and posttest results as the variables (line 84). And in the end, M_G summarized their decision that pretest and post testoutputs as the dependent variables (line 86). The members firstly indicated their individual ideas separately, and then the team reached the correct solution.

Line	Date	Post Time	Chat Message / Whiteboard Activity
77	12/11/2013	11:49 AM	Z_B: the first one, dependent and independent variables?
78	12/11/2013	11:51 AM	M_G: Pre test and Post test are dependent
79	12/11/2013	11:51 AM	Z_B: I thought reading comprehension could be dependent and three methods independent variables
80	12/11/2013	11:52 AM	H_A: methods are independent. agreed. but reading comprehension?
81	12/11/2013	11:52 AM	H_A: there are pretest and posttest results
82	12/11/2013	11:52 AM	H_A: i think these make reading comprehension observable
83	12/11/2013	11:52 AM	H_A: then no need read comprehension
84	12/11/2013	11:53 AM	Z_B: right, we need to use pre- and post test as the terms.
85	12/11/2013	11:53 AM	H_A: Yes
86	12/11/2013	11:53 AM	M_G: dependent is output, therefore Pre test and Post test are dependent

Analysis of the messages between lines 77 and 86 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. In the first message, M_G proposed that pretest and posttest as dependent variables. Then, Z_B offered the reading comprehension as dependent, and methods as independent variables. These messages were considered in *idea generation* phase. Between lines 80 and 83, H_A provided his ideas about the types of variables and compared them with prior offers. Therefore, these messages were considered in *idea connection* phase. He agreed with the categorization of methods as independent, but considered test scores as dependent variables. His offers were confirmed by other members in messages 84 and 86.

Scales of Variables

The group started to discuss about 2nd question which expects categorization of variables in terms of scales. H_A asked the scale categories if they consist of nominal, ordered variables (line 89) and the other two members provided confirmation for this question (line 90, 91). H_A offered pretest and posttest as ordered, group as nominal, and methods as nominal variables (line 92-94). Z_B confirmed that methods are nominal but had different idea for the

scales of test scores. She thought that test scores are in interval scale (line 95). H_A provided explanation from the textual statement of the question. That is, he indicated that the experiment investigates learners' performance according to the reading comprehension and makes an ordering among them (line 96-98). Z_B provided confirmation for the idea of H_A (line 99).

Line	Date	Post Time	Chat Message / Whiteboard Activity
87	12/11/2013	11:54 AM	H_A: q.2?
88	12/11/2013	11:55 AM	Z_B: at what level of scale are they measured?
89	12/11/2013	11:56 AM	H_A: is this about nominal, ordered variables something like that?
90	12/11/2013	11:56 AM	Z_B: I think so
91	12/11/2013	11:56 AM	M_G: hmm, i think
92	12/11/2013	11:57 AM	H_A: pre-test posttest ordered
93	12/11/2013	11:57 AM	H_A: group nominal
94	12/11/2013	11:58 AM	H_A: methods nominal
95	12/11/2013	11:58 AM	Z_B: I think methods are nominal, too, but I thought test scores are interval.
96	12/11/2013	11:59 AM	H_A: what the experiment is about which one makes them better on read comp.
97	12/11/2013	11:59 AM	H_A: this means which makes them prior according to other participant
98	12/11/2013	11:59 AM	H_A: 'prior' means ordering, i think
99	12/11/2013	12:00 PM	Z_B: yes, I first thought it must be ordinal, too, but then I remembered that we often say that test scores are interval, I am not so sure about the explanation now...

The messages between lines 87 and 99 can be analyzed based on the Progressive Knowledge Building Inquiry cycle as follows. In the message in line 88, Z_B shared the textual statement of the question, which is trigger activity that expects ideas of members about the scales of variables. Between messages 92 and 94, H_A suggested that test scores as ordered, group as nominal, and methods as nominal scales, hence these messages illustrated the *idea generation* phase. In the message in line 95, Z_B compared her idea with the one provided by H_A, and agreed that methods are nominal, but suggested that test scores are interval. Since there is a comparison in this message, it can be considered in *idea connection* phase. Between lines 96 and 99, H_A and Z_B explained the reasons of categorization for the test scores, hence demonstrated the *idea generation* phase.

Wiki Reflection

The group's most of the discussion was reflected as the wiki content. They already identified pretest and post test as dependent variables. However, they couldn't decide on scale of the tests in the chat environment. They thought that they can be interval or ordinal. The wiki output demonstrates that they finally decided them to be in ordinal scale. On the other hand, in order to be in ordinal scale, the categories should be structured in an ordered way. Such an order wasn't observed in the test scores. Therefore, the proper categorization for test scores

was interval scale since there were equal intervals and a score of 0 does not necessarily imply absence of reading comprehension skills.

Regarding the independent variables, instruction methods were categorized as independent and nominal. This grouping was correctly performed by the team.

Assignment-5

Dependent and Independent Variables

The group was talking about the way of doing analysis in the SPSS environment. For this purpose, Z_B suggested that they should know the way of entering data to SPSS, and investigate variables in the study (line 40). H_A provided confirmation for this suggestion (line 41) and categorized mood and "as many"/"like continue" as independent variables (line 42, 44, 45). Z_B had the same idea but named the second variable as stop_rule instead of "as many"/"like continue"(line 46). After this offer, H_A confirmed the naming stated by Z_B (line 47). After this process, Z_B proposed that they can enter them to SPSS (line 49), and H_A stated that he had the same idea (line 51).Z_B offered the items as the dependent variable of the study (line 52) and H_A provided confirmation for this suggestion (line 54). The solution demonstrated that the team correctly detected independent and dependent variables in the question.

Line	Date	Post time	Chat Message
40	12/23/2013	7:00 AM	Z_B: the important thing is to know how you are going to enter the data into spss and what the independent and dependent variables are
41	12/23/2013	7:00 AM	H_A: yes, i agree
42	12/23/2013	7:01 AM	H_A: mood
43	12/23/2013	7:01 AM	Z_B: and stop_rule are our independent variables
44	12/23/2013	7:01 AM	H_A: and "as many"/"like continue"
45	12/23/2013	7:01 AM	H_A: there are 2 independent variables
46	12/23/2013	7:01 AM	Z_B: yes, that's what I called "stop_rule"
47	12/23/2013	7:01 AM	H_A: yes agree
48	12/23/2013	7:01 AM	H_A: name is stop_rule
49	12/23/2013	7:02 AM	Z_B: right so we are going to enter two variable for them into spss
50	12/23/2013	7:01 AM	H_A: :)
51	12/23/2013	7:02 AM	H_A: you are right :)
52	12/23/2013	7:02 AM	Z_B: and then one for items generated, which is our dependent variable
54	12/23/2013	7:02 AM	H_A: agree

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 40 and 54 can be analyzed as follows. The initial message of Z_B recommends the importance of identifying dependent and independent variables, hence considered as trigger activity that aims to obtain ideas of members. Between messages 42 and 48, H_A and Z_B categorized the mood and stop rule as independent variables, hence considered in *idea generation* phase.

In the message in line 52, Z_B offered the items generated as dependent variable, which also demonstrated the *idea generation* phase. This offer was accepted by H_A in message 54.

Wiki Reflection

In the chat environment, the group categorized the variable - Obsessive Compulsive Behavior (Items Generated) as dependent. Similar decision was also observed in the wiki output. The only contribution related to that variable is that it was identified in interval scale, which was a correct categorization.

The mood and stop rule were categorized as independent variables in the chat environment. Similarly, the same idea was valid in the wiki environment. The initial difference in the wiki output is that the naming for stop rule was changed to instruction (as many as you can, feel like continuing). In addition, the group identified scales of independent variables as nominal in the wiki output. The categorizations were correctly provided by the team.

Assignment-7

Dependent and Independent Variables

H_A indicated his understanding from the experiment that there are students taking courses and their course scores are listed in three continuing years (line 20-25). Z_B implied that she had same understanding as H_A (line 26). Then, H_A started to offer dependent and independent variables of the experiment. According to his idea, the year is independent and course scores are dependent variables (line 27, 29). Other members (i.e. M_G and Z_B) indicated their agreement to the ideas of H_A (line 28, 30). At the end, H_A concluded that there are one independent variable and five dependent variables since there are five different courses in the study (line 31).

Line	Date	Post time	Chat Message
20	01/09/2014	2:25 PM	H_A: the things that i understood in the experiment
21	01/09/2014	2:25 PM	H_A: is
22	01/09/2014	2:25 PM	H_A: that there are students, they took five course
23	01/09/2014	2:25 PM	H_A: and the scores of the courses are listed
24	01/09/2014	2:25 PM	H_A: for three continuing year
25	01/09/2014	2:25 PM	H_A: s
26	01/09/2014	2:26 PM	Z_B: exactly
27	01/09/2014	2:26 PM	H_A: year is independent list
28	01/09/2014	2:26 PM	M_G: yes
29	01/09/2014	2:26 PM	H_A: and courses are dependentList
30	01/09/2014	2:26 PM	Z_B: right
31	01/09/2014	2:26 PM	H_A: 5 dependent variable 1 independent variable

Analysis of the messages between lines 20 and 31 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. Between lines 20 and 25, H_A explained his understanding of the question, which can be considered trigger activity that encourages members to produce ideas. In line 26, Z_B provided agreement to the

explanations of H_A. Then, H_A offered that year is independent and courses are dependent variables, which are considered in *idea generation* phase. Other members indicated their agreements to the offers in lines 28 and 30.

Wiki Reflection

The group's decision about dependent (i.e. score of courses) and independent variables (i.e. year) in the chat were completely reflected to the wiki output. The only difference is that the wiki output consists of scales of the variables. That is, the year was categorized in nominal and course scores were categorized in interval scales. The groupings were correctly performed by the team.

Experience of the Team throughout Assignments

In the first assignment, the team initially experienced misunderstanding about the statement of the question. Then, with the clarification of one team member, the team gained understanding and correctly categorized dependent and independent variables. In the fourth, fifth, and seventh assignments, the team also didn't face with any problem in detecting dependent and independent variables.

In the second assignment, the team collaborated to identify scales of variables. They properly categorized the gender in binary scale, weight and height in ratio scales. Additionally, they identified the brain volume and intelligence in ordinal scales by stating that there is no true zero and equal intervals don't represent equal differences in the property being measured. On the other hand, their solution and interpretation was not appropriate. Brain volume is in ratio scale because of existence of ratios along the scales, and occurrence of a true and meaningful zero. In addition, intelligence variable should be categorized in interval scale. This is because it consists of equal intervals but not ratios along the scales. The team's problem related to scale of variables was also observed in this assignment. They categorized test scores in ordinal scale. On the other hand, in order to be in ordinal scale, the categories should be structured in an ordered way. Such an order wasn't observed in the test scores. Therefore, the proper categorization for test scores was interval scale since there were equal intervals and a score of 0 does not necessarily imply absence of reading comprehension skills. In the fifth and seventh assignment, the team showed progress and correctly identified interval variables.

Individual Progress of Team Members

H_A: In the first assignment, H_A offered the number of towers as independent, and the number of steps as dependent variable. On the other hand, the solution provided by H_A addressed to the tower of Hanoi (TOH) puzzle instead of the question relating to types of variables. With the notification of other team members, he could understand that the actual variables are puzzles, three conditions (picture, blank and fixation), and time consuming for the problem solving. Among these variables, Z_B offered conditions as independent and time consuming as dependent variable. As a response, H_A indicated his agreement to this offer.

In the second assignment, the group listed the variables as gender, weight, height, brain volume, intelligence(IQ scores). Z_B categorized gender in binary, and weight and height in ratio scales. Although H_A agreed with the scale of gender, he thought that weight and height should be in interval scale. According to his opinion, there should be ratio for the ratio

variable but one can never say the height is double of some one. On the other hand, Z_B explained the difference between ratio and interval variable as the existence of a true zero in ratio, and considered the weight and height the examples of ratio variable. At first, H_A didn't agree with statements provided by Z_B. Yet, after her clarifications, H_A understood that weight and height are in ratio scale. H_A categorize the brain volume in ratio and intelligence in interval scale. Although this was a correct categorization, Z_B offered them as ordinal variables by stating the meaningful comparison for their scores.

In the fourth assignment M_G offered the tests as dependent variables. Yet, Z_B thought that reading comprehension as dependent and three methods as independent variables. H_A offered the methods as independent, test results as dependent variables and ignore reading comprehension as a variable. After this explanation, Z_B was persuaded that they need to consider pretest and posttest results as the variables. And then, M_G summarized their decision that pretest and post test outputs as the dependent variables. Regarding variable scales, H_A offered pretest and posttest as ordered, group as nominal, and methods as nominal variables. On the other hand, Z_B thought that test scores are in interval scale. H_A provided explanation from the textual statement of the question. That is, he indicated that the experiment investigates learners' performance according to the reading comprehension and makes an ordering among them. As a results, Z_B provided confirmation for the idea of H_A.

In the fifth assignment, H_A categorized mood and "as many"/"like continue" as independent variables. Z_B had the same idea but named the second variable as stop_rule instead of "as many"/"like continue". After this offer, H_A confirmed the naming stated by Z_B.

In the seventh assignment, H_A categorized the year as independent and course scores as dependent variables. Other members (i.e. M_G and Z_B) indicated their agreement to the ideas of H_A.

Z_B: In the first assignment, H_A experienced problem in understanding variables of the study. Z_B provided appropriate explanations and allowed H_A to detect the actual variables in the study. In addition, Z_B correctly identified dependent and independent variables.

In the second assignment, Z_B listed the variables as gender, weight, height, brain volume, intelligence(IQ scores). And then, she categorized gender in binary, and weight and height in ratio scales. Although H_A agreed with the scale of gender, he thought that weight and height should be in interval scale. According to his opinion, there should be ratio for the ratio variable but one can never say the height is double of some one. On the other hand, Z_B explained the difference between ratio and interval variable as the existence of a true zero in ratio, and considered the weight and height the examples of ratio variable. At first, H_A didn't agree with statements provided by Z_B. Yet, after her clarifications, H_A understood that weight and height are in ratio scale. H_A categorize the brain volume in ratio and intelligence in interval scale. Although this was a correct categorization, Z_B offered them as ordinal variables by stating the meaningful comparison for their scores.

In the fourth assignment, Z_B proposed reading comprehension as dependent and three methods as independent variables. However, H_A stated that they should consider test scores instead of reading comprehension. Z_B accepted this offer and gained understanding. About the scales of variables, she stated that methods in nominal and test scores in interval scale.

Although the team finally decided that test scores are in interval scale, the grouping provided by Z_B was correct.

In the fifth and seventh assignment, Z_B provided her agreements about the identification of dependent and independent variables.

M_G:M_G didn't generally provide contribution to the collaborative study. In the second assignment, while Z_B was trying to explain the true zero concept, he provided the Fahrenheit as the variable with true zero variable. However, other members informed him that 0 value of Fahrenheit doesn't mean that there is no temperature. After this explanation, he understood the true zero concept.

In the fourth assignment, M_G correctly identified dependent and independent variables. In the fifth assignment he provided agreement to the offer about variable categories.

Normality Test

Assignment-4

H_A initiated the discussion by asking other members' opinions about the second question (line 101). As a response, Z_B explained that she had considered the results of Kolmogorov for the normality test (line 102) and offered to apply the Levene test for the homogeneity of variance (line 103). H_A agreed with the offers of Z_B (line 104).

According to the results of his normality analysis, H_A stated that he found pretest normal and post test as non –normal (line 105, 106). However, Z_B didn't provide confirmation for these results (line 107, 108). She stated that she found variables 1 and 3 as normal (line 110, 111)by indicating their significance values (line 113). Yet, H_A couldn't understand the meaning of variables 1 and 3 (line 112). Z_B replied that the variables refer groups (line 114). As a response, H_A indicated that he considered the whole data instead of grouping them (line 115, 116). Therefore, he asked the purpose of applying normality test for three different groups (line 118). Z_B provided the question statement that directs the learners to "use the appropriate group level for these tests" (line 119). Moreover, M_G had same idea as Z_B. He offered to consider groups separately since there are 3 groups for pre test and 3 groups for post test (line 120, 122). On the other hand, H_A understood the question as covering the whole data without any mention about the group specification (line 123, 124). Z_B stated that the question expects to consider grouped data while applying the normality test (line 125). Then, H_A gained understanding and approved the statement provided by Z_B (line 126-128). In addition, Z_B provided her opinion about the grouping data. That is, she offered that they can obtain more reliable analysis results if they apply the normality test for each group separately (line 129). H_A accepted this idea (line 134)but thinking it as a complicated process (line 136). That is, he thought that normality tables should be produced for each group separately (line 139). On the other hand, Z_B didn't consider it as a complicated process (line 140). She listed the analysis steps to be applied in the SPSS environment (line 141-147). After this explanation, H_A expected to do the analysis by himself (line 149) and stated that he found the test results normal for second group and non-normal for other groups (line 151, 152). Then, he asked if others agreed with these results (line 153). However, Z_B interpreted the results in the opposite way that she found all the results normal except the ones for second group (line 154). Moreover, she provided explanation for the interpretation of the normality results. That is, she considered the data normal when the result is significant; and non-normal when the result is not significant (line

154, 155). H_A understood that his results were the inverse according to the ones provided by Z_B (line 157). Since he experienced confusion, he offered to review the previous homework (line 158). In order to facilitate understanding of H_A, Z_B shared the notes from the course slides: Significant = non-Normal data Non-Significant = Normal data (line 159). M_G provided confirmation for this explanation (line 161). H_A also understood the interpretation (line 162) but explained his earlier incorrect understanding and solution related to this issue (line 163, 164).

Line	Date	Post time	Chat Message
101	12/11/2013	12:01 PM	H_A: question 2?
102	12/11/2013	12:02 PM	Z_B: the normality test? I used kolmogorov again.
103	12/11/2013	12:03 PM	Z_B: and for the homogenity we need to use Levene test (I remembered it after the exam, though...)
104	12/11/2013	12:03 PM	H_A: yes agreed
105	12/11/2013	12:03 PM	H_A: pretest is normal
106	12/11/2013	12:03 PM	H_A: post test is not
107	12/11/2013	12:03 PM	Z_B: nope
108	12/11/2013	12:03 PM	Z_B: I think
109	12/11/2013	12:03 PM	Z_B: I found in both cases
110	12/11/2013	12:04 PM	M_G: i think we need to see significance in tests of Normality
111	12/11/2013	12:04 PM	Z_B: variables 1 and 3 are normally distributed
112	12/11/2013	12:04 PM	H_A: variables 1 and 3?
113	12/11/2013	12:04 PM	Z_B: In the pre test, the variables 1 (Sig. = .076) and 3 (Sig. = .112) seem to be normally distributed as the scores are not significant (p > .05)
114	12/11/2013	12:04 PM	Z_B: I mean groups
115	12/11/2013	12:05 PM	H_A: i took them as whole
116	12/11/2013	12:05 PM	H_A: no group difference
117	12/11/2013	12:05 PM	Z_B: hmm
118	12/11/2013	12:05 PM	H_A: why do you separate normality test for 3 groups?
119	12/11/2013	12:06 PM	Z_B: "use the appropriate group level for these tests"
120	12/11/2013	12:06 PM	M_G: we have 3 group for pre test and 3 group post test
121	12/11/2013	12:06 PM	H_A: yes i know
122	12/11/2013	12:06 PM	M_G: i think we need to see all groups separately
123	12/11/2013	12:06 PM	H_A: but the question is a general question about normality
124	12/11/2013	12:06 PM	H_A: no specific mention about group specification
125	12/11/2013	12:06 PM	Z_B: the question says
126	12/11/2013	12:06 PM	H_A: ha ok
127	12/11/2013	12:06 PM	H_A: your are right
128	12/11/2013	12:06 PM	H_A::)
129	12/11/2013	12:07 PM	Z_B: and i think it is better if we do the normality test for each group, so we can have more reliable scores.
134	12/11/2013	12:07 PM	H_A: ok

135	12/11/2013	12:07 PM	H_A: then you did as homework 1?
136	12/11/2013	12:07 PM	H_A: or are there an easy way?
137	12/11/2013	12:07 PM	Z_B: yes
138	12/11/2013	12:07 PM	H_A: ok
139	12/11/2013	12:07 PM	H_A: i think we should save the normality table values for each group
140	12/11/2013	12:08 PM	Z_B: no
141	12/11/2013	12:08 PM	Z_B: I mean
142	12/11/2013	12:08 PM	Z_B: analyze
143	12/11/2013	12:08 PM	Z_B: explore
144	12/11/2013	12:08 PM	Z_B: then I used
145	12/11/2013	12:08 PM	Z_B: pre and post test as dependent
146	12/11/2013	12:08 PM	Z_B: and group as factor
147	12/11/2013	12:08 PM	Z_B: and I got the result
148	12/11/2013	12:08 PM	H_A: hmm
149	12/11/2013	12:08 PM	H_A: let me do that
150	12/11/2013	12:08 PM	Z_B: ok
151	12/11/2013	12:09 PM	H_A: post-2 and pre-2 are normal
152	12/11/2013	12:09 PM	H_A: others not
153	12/11/2013	12:09 PM	H_A: agree?
154	12/11/2013	12:09 PM	Z_B: if the result is significant, then we say the data is not normally distributed, so only 2 in both pre and post tests are not normally distributed ones
155	12/11/2013	12:10 PM	Z_B: it is normal if they are not significant.
156	12/11/2013	12:10 PM	Z_B: as far as I know...
157	12/11/2013	12:11 PM	H_A: then you said reverse?
158	12/11/2013	12:12 PM	H_A: let me look at the homework 1
159	12/11/2013	12:12 PM	Z_B: Significant = non-Normal data Non-Significant = Normal data
160	12/11/2013	12:12 PM	Z_B: from the powerpoint
161	12/11/2013	12:13 PM	M_G: yes
162	12/11/2013	12:13 PM	H_A: yes you are right
163	12/11/2013	12:13 PM	H_A: somehow i learnt in this way
164	12/11/2013	12:13 PM	H_A: then i made wrong in the midterm
165	12/11/2013	12:13 PM	Z_B: :(
166	12/11/2013	12:16 PM	H_A: no matter
167	12/11/2013	12:16 PM	H_A: lets continue
168	12/11/2013	12:16 PM	H_A::)

We analyzed messages between lines 100 and 168 according to the Progressive Knowledge Building Inquiry cycle in the following way. Initial message illustrated the trigger activity

that aims to obtain solutions for the question 2. Then, Z_B proposed the solutions that they should apply kolmogorov for normality, and levene test for homogeneity of variance in lines 102 and 103, which are considered in *idea generation* phase. H_A agreed with the idea and stated that he found pretest normal and posttest non-normal (line 104-106). However, Z_B indicated that she found both tests normal (line 107-109). More specifically, she found groups 1 and 3 as normal (line 111, 113, 114). These proposes were considered in *idea generation* phase. H_A experienced confusion and asked if there should be grouping before applying the normality test (line 118). Z_B and M_G provided explanations for the appropriateness of grouping, which demonstrated the *idea generation* (line 119, 120, 122). As a result, H_A gained understanding and accepted to apply grouping (line 127, 128). Then, he asked the way of applying normality test by considering the groups (line 139). Between lines 141 and 147, Z_B listed the steps that she followed, which are considered in *idea generation* phase. H_A applied the same steps and indicated his results that he found post-2 and pre-2 groups normal, and other groups non-normal (line 149-152), which demonstrated the *idea generation* phase. Z_B compared her results and proposed the reverse interpretations (line 154, 155), which are considered in *idea connection* phase. H_A experienced confusion about the difference of the results (line 157). Z_B provided the explanation from the course slide that "Significant = non-Normal data Non-Significant = Normal data" (line 159), which was accepted by M_G (line 161) and H_A (line 162).

They continued to interpret normality results after the offer of H_A (line 167). According to the findings of M_G, group1 and 2 in pre test are significant, and other conditions are normal (line 169, 171). However, Z_B stated that she found non-significant result for the group 1 in pretest condition (line 172) and asked results of other members (line 173). H_A stated that he obtained the same result as Z_B and interpreted it as normal (line 174, 175). M_G asked the test they considered in their interpretation (line 176). Z_B and H_A replied that they had interpreted the results of the Kolmogorov test (line 178, 179). M_G expected to learn the reason of considering results of Kolmogorov test (line 181). Z_B didn't provide essential explanation since she thought that this test was always considered during the interpretation of normality results (line 182). Yet, other members provided confirmation for this explanation. At the end, M_G reached the same normality results as his group members (line 185).

Line	Date	Post time	Chat Message
169	12/11/2013	12:18 PM	M_G: i think group1 and 2 in pre test are significant (<0.05)
170	12/11/2013	12:18 PM	H_A: it seems that i made wrong all of them
171	12/11/2013	12:19 PM	M_G: but others are normally distributed
172	12/11/2013	12:19 PM	Z_B: in the pre-test? I found 1 as 0.76
173	12/11/2013	12:19 PM	Z_B: what did you find?
174	12/11/2013	12:19 PM	H_A: the same
175	12/11/2013	12:20 PM	H_A: then it is normal
176	12/11/2013	12:20 PM	M_G: which method?
177	12/11/2013	12:20 PM	M_G: kolmogorov
178	12/11/2013	12:20 PM	Z_B: pre-test first group kolmogorov yes
179	12/11/2013	12:20 PM	H_A: kolmogorow
180	12/11/2013	12:20 PM	M_G: or Shapiro
181	12/11/2013	12:20 PM	M_G: why kolmogorov

182	12/11/2013	12:21 PM	Z_B: we always used it for the test of normality.
183	12/11/2013	12:21 PM	H_A: agreed
184	12/11/2013	12:21 PM	M_G: hmm, ok
185	12/11/2013	12:22 PM	M_G: in this way, post group 2 and pre group 2 are <0.05
186	12/11/2013	12:22 PM	Z_B: yes
187	12/11/2013	12:23 PM	H_A: yes

Analysis of the messages between lines 169 and 187 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. M_G provided the results of the normality test that "group1 and 2 in pre test are significant" (line 169) and "others are normally distributed" (line 171), which are considered in *idea generation* phase. On the other hand, Z_B reported that she found group1 non-significant (172) and similarly H_A indicated the non-normal result (line 175), which illustrated the *idea connection,* since they compared the results and indicated the difference. M_G asked the test they considered (176) and the reason of choice (181). Z_B couldn't provide appropriate explanation, just offered that kolmogorov test was always considered during the interpretation of normality results (line 182), which is considered in *idea generation* phase. Other members provided confirmation for this explanation. And finally, M_G found the same normality results as his group members (line 185).

Experience of the Team throughout Assignments

In the fourth assignment, H_A shared results of the normality test. While conducting the analysis, he considered the whole data instead of grouping them. On the other hand, Z_B stated that she applied the analysis by grouping the data by referring to the question statement. Similarly, M_G thought that grouping should be done before applying the normality test. Then, H_A gained understanding and approved the statement provided by Z_B. However, he stated it as a complicated process since he thought that normality tables should be produced for each group separately. On the other hand, Z_B didn't consider it as a complicated process and listed the analysis steps to be applied in the SPSS environment. After this explanation, H_A expected to do the analysis by himself.

H_A interpreted test results normal for second group and non-normal for other groups. Yet, Z_B interpreted the results oppositely that she found all the results normal except the ones for second group. Moreover, she provided explanation that Significant = non-Normal data, Non-Significant = Normal data. M_G provided confirmation for this explanation. Then, H_A understood the correct way of interpretation.

They continued to interpret normality results. According to the findings of M_G, group1 and 2 in pre test are significant, and other conditions are normal. However, Z_B stated that she found non-significant result for the group 1 in pretest condition. H_A stated that he obtained the same result as Z_B. M_G asked the test they considered in their interpretation. Z_B and H_A replied that they had interpreted the results of the Kolmogorov test. M_G expected to learn the reason of considering results of Kolmogorov test. Z_B thought that this test was always considered during the interpretation of normality results. As a result, M_G reached the same normality results as his group members.

OTHER CONCEPTS

ASSIGNMENT-3

A researcher has asked a sample of voters in a country to rate their support for the current government (status quo), their educational level, age, gender, annual income, and whether they will vote Yes or No in an upcoming referendum. 1757 of the interviewees agreed to declare their vote. The dataset is provided in Voting.sav file.

Conduct a logistic regression analysis on this data to see which factors might be useful for predicting voting behavior in this country. In particular, construct separate models where:

i) age is the only predictor
ii) government support is the only predictor
iii) a model including all variables with Backward:Wald as the data entry method.

Model Fit

The first question has the following statement: Is this model a significant fit to the data? Why or why not?

For the solution of this question, Z_B suggested to check the log-likelihood value. M_G shared the same idea with Z_B and shared the book explanation about the appropriateness of the log-likelihood value: "The overall fit of the final model is shown by the log-likelihood statistic and its associated chi-square statistic. If the significance of the chi-square statistic is less than .05, then the model is a significant fit of the data."

Z_B applied the test and shared the results that she found. According to her findings, the baseline model is 2435.468 and the value is reduced to 2394.072 when the age predictor is included. She interpreted that it is a significant fit and shared the chi-square value as 41.397 with p value <.001. H_A stated that he found the same chi square value as Z_B.

H_A didn't actually know how to interpret findings. Therefore, he asked the value that they should consider while checking fit of the model to data. M_G explained that "If the significance of the chi-square statistic is less than .05, then the model is a significant fit of the data." by providing a resource from the book. H_A gained understanding.

Line	Date	Post Time	Chat Message
17	11/24/2013	10:48 AM	Z_B: the first q. is this model a significant fit to the data?
18	11/24/2013	10:49 AM	H_A: a suggestion?
19	11/24/2013	10:49 AM	H_A: or see each other's result
20	11/24/2013	10:49 AM	Z_B: we need to look into log-likelihood
21	11/24/2013	10:49 AM	M_G: The overall fit of the final model is shown by the log-likelihood statistic and its associated chi-square statistic. If the significance of the chi-square statistic is less than .05, then the model is a significant fit of the data.
22	11/24/2013	10:49 AM	M_G: i find it in the book
23	11/24/2013	10:49 AM	Z_B: baseline model: is 2435.468
24	11/24/2013	10:50 AM	Z_B: when the age predictor included
25	11/24/2013	10:50 AM	Z_B: it is reduced to 2394.072
26	11/24/2013	10:50 AM	Z_B: which means it is a significant fit

27	11/24/2013	10:50 AM	Z_B: that’s what i understood
28	11/24/2013	10:51 AM	Z_B: if we look the model chi-square, it is 41.397
29	11/24/2013	10:51 AM	Z_B: and it is p < .001
30	11/24/2013	10:51 AM	Z_B: I think this also answers item c?
31	11/24/2013	10:52 AM	Z_B: what did you find?
32	11/24/2013	10:52 AM	H_A: let me first put them in spss :)
33	11/24/2013	10:53 AM	Z_B: right, sorry :)
34	11/24/2013	10:55 AM	H_A: i found chi-square 41.397
35	11/24/2013	10:56 AM	H_A: to find if it fit the data, which value is more important?
36	11/24/2013	10:57 AM	H_A: classification table?
37	11/24/2013	10:57 AM	H_A: variables in the equation table?
38	11/24/2013	10:57 AM	H_A: omnibus test of model coefficient?
39	11/24/2013	10:57 AM	H_A: i watch the youtube video that sent to you
40	11/24/2013	10:58 AM	H_A: the things i understand
41	11/24/2013	10:58 AM	H_A: in the classification table age can only predict %50
42	11/24/2013	10:58 AM	H_A: therefore it is not good
43	11/24/2013	10:59 AM	M_G: i think it is significant fit
44	11/24/2013	10:59 AM	M_G: according to the book
45	11/24/2013	10:59 AM	M_G: If the significance of the chi-square statistic is less than .05, then the model is a significant fit of the data.
46	11/24/2013	11:00 AM	M_G: sig in chi-square id 0
47	11/24/2013	11:00 AM	M_G: it is less than .05
49	11/24/2013	11:02 AM	H_A: let me check again
50	11/24/2013	11:03 AM	M_G: page 290 of book, Cramming sam's tips
51	11/24/2013	11:12 AM	H_A: i read sam's tip
52	11/24/2013	11:12 AM	H_A: yes
54	11/24/2013	11:14 AM	M_G: for part a) we can write the sam's tip
55	11/24/2013	11:15 AM	M_G: for age only it is fit
56	11/24/2013	11:15 AM	H_A: yes
57	11/24/2013	11:16 AM	M_G: for government support
58	11/24/2013	11:16 AM	M_G: sig is 0 again
59	11/24/2013	11:16 AM	M_G: it is fit
60	11/24/2013	11:16 AM	M_G: i think

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 17 and 60 can be analyzed as follows. The initial message can be regarded as trigger activity that aims to obtain solutions of members for the significance of the model. Z_B suggested to check log likelihood (line 20), which can be considered in *idea generation* phase. M_G applied to the book explanation and indicated that they should check chi-square statistic relate to log-likelihood, which is considered in *idea connection* phase (line 20). Between lines 23 and 29, Z_B explained her findings about the model and chi square value, which are

considered in *idea generation* phase. H_A indicated that he found the same chi-square value as Z_B (line 34). Then, he asked the value to be considered while checking fit of data (line 35). M_G shared the book explanation that when "the chi-square statistic is less than .05, then the model is a significant fit of the data" (line 45), which illustrated the *idea connection* phase. H_A read the same explanations from the book and agreed with M_G.

Wald

Understanding Wald

H_A expected to understand the way of explaining wald statistic. Based on book content, M_G explained that "the Wald statistic tells whether the b coefficient for that predictor is significantly different from zero. If the coefficient is significantly different from zero then one can assume that the predictor is making a significant contribution to the prediction of the outcome (Y)". In other words, M_G offered to check the significance of b coefficient value. H_A agreed on considering b coefficient and stated its equivalence to exp(b). Additionally, he stated that wald effects s.e.

Wald Results

H_A and M_G found the same b and exp(b) results. They discussed about using results belong to block 0 or block 1. Each offered to use results belong to 1. According to H_A, the reason of using block 0 is that it predicts only no vote case whereas block1 predicts both cases.

Line	Date	Post Time	Chat Message
110	11/24/2013	11:53 AM	H_A: then how can we explain wald?
111	11/24/2013	11:54 AM	M_G: :D
112	11/24/2013	11:54 AM	M_G: we must find wald statistic in the book
113	11/24/2013	11:54 AM	M_G: and the meaning of it
114	11/24/2013	11:55 AM	M_G: page 269
115	11/24/2013	11:56 AM	H_A: page 310
116	11/24/2013	11:56 AM	M_G: the Wald statistic tells us whether the b coefficient for that predictor is significantly different from zero. If the coefficient is significantly different from zero then we can assume that the predictor is making a significant contribution to the prediction of the outcome (Y):
117	11/24/2013	11:59 AM	H_A: yes
118	11/24/2013	11:59 AM	H_A: same for exp(b)
119	11/24/2013	11:59 AM	H_A: and wald effects s.e
120	11/24/2013	12:00 PM	H_A: what is b and exp(b)
121	11/24/2013	12:00 PM	H_A: in your table
122	11/24/2013	12:00 PM	H_A: mine is
123	11/24/2013	12:00 PM	H_A: -0.24
124	11/24/2013	12:00 PM	H_A: sorry

125	11/24/2013	12:00 PM	H_A:-0.024
126	11/24/2013	12:01 PM	H_A: and
127	11/24/2013	12:01 PM	H_A:0.976
128	11/24/2013	12:01 PM	H_A: according to exp, it has no great affect
129	11/24/2013	12:01 PM	H_A: it affects but less
130	11/24/2013	12:02 PM	M_G: B = .021
131	11/24/2013	12:02 PM	M_G: Exp(B) = 1.021
132	11/24/2013	12:03 PM	M_G: sorry
133	11/24/2013	12:03 PM	M_G: variables for block 0, or for block 1?
134	11/24/2013	12:04 PM	H_A: you put block 1
135	11/24/2013	12:04 PM	H_A: it is same as mine for block 1
136	11/24/2013	12:04 PM	M_G: ok
137	11/24/2013	12:04 PM	M_G: we can put both :D
138	11/24/2013	12:04 PM	H_A: then we will use which one?
139	11/24/2013	12:05 PM	M_G: but the explanation of those tables are different
140	11/24/2013	12:05 PM	M_G: i confuse
141	11/24/2013	12:06 PM	H_A: how?
142	11/24/2013	12:07 PM	H_A: Z_B?
143	11/24/2013	12:07 PM	M_G: i think we have to explain block 1
144	11/24/2013	12:07 PM	M_G: block 0 does not have lower and upper part
145	11/24/2013	12:08 PM	M_G: and in that link, she explain variables in a table which has lower and upper part
146	11/24/2013	12:10 PM	H_A: we have to use block 1 because in the block 0 only no vote is predicted
147	11/24/2013	12:10 PM	H_A: in block 1 both
148	11/24/2013	12:10 PM	H_A: yes
149	11/24/2013	12:10 PM	H_A: you are right

Analysis of the messages between lines 110 and 149 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. In the initial message, H_A asked the way of explaining wald statistics. By referring to the book, M_G explained that wald statistics provided the significance of the b coefficient (line 116), which illustrated the *idea connection* phase. Between lines 122 and 136, H_A and M_G shared the b and exp (b) values of block 0 and 1, which are considered in *idea generation* phase. Between lines 143 and 149 H_A and M_G talked about the use of results and decided to use ones belong to block1, which demonstrated the *idea connection* phase.

Question c

The question c has the following statement: How does the prediction power of the model compare to the baseline model?

As the solution of the question c, H_A stated that the first table demonstrates the base line. Then, he offered the predictions of block1 as 889 for no case and 868 for yes case. In addition, he provided ratios for no and yes cases.

Z_B shared the baseline model as 50.6 and interpreted its increase to 56.5 with inclusion of age. Then, H_A interpreted that it is not good prediction. Although Z_B agreed on its lack of prediction, she indicated its goodness than baseline. Yet, H_A couldn't achieve understanding firstly. By the explanations of Z_B, he understood the increase in model, hence in prediction capability.

M_G asked if overall percentage must be compared in classification table. As a response, Z_B indicated that they compared overall percentage in step1 and baseline model. Then, M_G stated that 1st classification table shows baseline hence they can see increase in percentage. Moreover, he offered to consider two table and report the comparison. H_A shared the related book page and offered that they can compare by S.E. According to the resource he shared, he interpreted that since S.E decreases, it fits and predicts better. After this interpretation, M_G offered to report results belong to both methods and others agreed.

Line	Date	Post Time	Chat Message
185	11/24/2013	12:28 PM	H_A: i can say something on c
186	11/24/2013	12:28 PM	Z_B: I compared correct and false predictions
187	11/24/2013	12:29 PM	H_A: the first table is our base line
188	11/24/2013	12:28 PM	Z_B: yes, H_A
189	11/24/2013	12:29 PM	H_A: the block 1 has predictions
190	11/24/2013	12:29 PM	H_A: in base line
191	11/24/2013	12:29 PM	H_A: there are 889 no
192	11/24/2013	12:29 PM	H_A: and 868 yes
193	11/24/2013	12:29 PM	H_A: on predicted ones
194	11/24/2013	12:29 PM	H_A: block 1
195	11/24/2013	12:30 PM	H_A: for no: 580 no / 309 yes
196	11/24/2013	12:30 PM	H_A: for yes: 456 no / 412 yes
197	11/24/2013	12:30 PM	H_A: then we have
198	11/24/2013	12:30 PM	H_A: for no: 580/889
199	11/24/2013	12:31 PM	H_A: for yes: 456/889 no
200	11/24/2013	12:31 PM	H_A: let me find the interval
201	11/24/2013	12:31 PM	H_A: just a second
202	11/24/2013	12:31 PM	H_A: 0.51-0.65
203	11/24/2013	12:31 PM	H_A: for no
204	11/24/2013	12:32 PM	H_A: it will be same for yes i guess
205	11/24/2013	12:33 PM	Z_B: yes overall, the baseline model predicted 50.6% correctly, but with the inclusion of age as the predictor, it has risen to 56.5%
206	11/24/2013	12:32 PM	H_A: it is not so good prediction i think
207	11/24/2013	12:33 PM	Z_B: yes, I agree.
208	11/24/2013	12:33 PM	H_A: yes 0.51+0.65/2=0.58

209	11/24/2013	12:33 PM	Z_B: nope
210	11/24/2013	12:33 PM	Z_B: sorry
211	11/24/2013	12:33 PM	Z_B: I is better than the baseline
212	11/24/2013	12:33 PM	Z_B: isn't it
213	11/24/2013	12:33 PM	H_A: but baseline is raw data
214	11/24/2013	12:34 PM	Z_B: ok the question asks whether the model with the predictor is better than the baseline
215	11/24/2013	12:34 PM	Z_B: and the results shows it predicts better
216	11/24/2013	12:34 PM	Z_B: right?
217	11/24/2013	12:34 PM	H_A: how
218	11/24/2013	12:35 PM	H_A: there are 1757 data
219	11/24/2013	12:35 PM	H_A: let make fifty fifty
220	11/24/2013	12:35 PM	H_A: 889 yes and other
221	11/24/2013	12:35 PM	Z_B: the baseline model predicts that everyone says no
222	11/24/2013	12:35 PM	H_A: but prediction is so low
223	11/24/2013	12:35 PM	Z_B: but the current model has a better accuracy
224	11/24/2013	12:36 PM	H_A: are there 889 in the data
225	11/24/2013	12:37 PM	H_A: who says no
226	11/24/2013	12:39 PM	Z_B: well I think so
227	11/24/2013	12:40 PM	Z_B: the baseline model perfectly works for No, which is 100% but it is 0% for Yes
228	11/24/2013	12:40 PM	Z_B: the current model also includes
229	11/24/2013	12:40 PM	Z_B: Yes
230	11/24/2013	12:40 PM	Z_B: that's why the overall percentages has risen to 56.5
231	11/24/2013	12:41 PM	Z_B: I think
232	11/24/2013	12:42 PM	H_A: then the only argument is since we have larger percentage
233	11/24/2013	12:42 PM	H_A: 0.58 > 0.50
234	11/24/2013	12:42 PM	H_A: then it predicts better then base line
235	11/24/2013	12:43 PM	H_A: am i right?
236	11/24/2013	12:43 PM	Z_B: 0.58?
237	11/24/2013	12:43 PM	H_A: 0.56
238	11/24/2013	12:43 PM	Z_B: yes
239	11/24/2013	12:43 PM	H_A: sorry
240	11/24/2013	12:43 PM	Z_B: you can see page 286
241	11/24/2013	12:43 PM	Z_B: for a similar explanation
242	11/24/2013	12:43 PM	Z_B: for the example
243	11/24/2013	12:44 PM	M_G: in classification table, overall percentage must be compare?
244	11/24/2013	12:45 PM	Z_B: yes, we compare the overall percentage in step1 - classification table and the one in the baseline model.
245	11/24/2013	12:45 PM	M_G: first classification table show baseline

246	11/24/2013	12:46 PM	M_G: therefore we can see increasing in percentage
247	11/24/2013	12:46 PM	Z_B: I think so
248	11/24/2013	12:47 PM	M_G: ok, we can put these 2 table and write these comparison
249	11/24/2013	12:48 PM	H_A: please see page 308
250	11/24/2013	12:48 PM	Z_B: yes
251	11/24/2013	12:48 PM	H_A: we can compare them by S.E
252	11/24/2013	12:48 PM	H_A: S.E decreases
253	11/24/2013	12:48 PM	H_A: therefore it fits better
254	11/24/2013	12:48 PM	H_A: and predicts better
255	11/24/2013	12:49 PM	M_G: ok, we can write both methods
256	11/24/2013	12:49 PM	Z_B: ok
257	11/24/2013	12:49 PM	H_A: yes
258	11/24/2013	12:49 PM	H_A: both are true
259	11/24/2013	12:49 PM	H_A: i guess

We analyzed messages between lines 185 and 259 according to the Progressive Knowledge Building Inquiry cycle in the following way. Between lines 189 and 204, H_A provided the block 1's predictions and ratios for yes and no cases, which demonstrated the *idea generation* phase. Then, Z_B explained the increase in baseline model with inclusion of age, which is considered in *idea generation* phase (line 205). However, H_A thought that it is not good prediction (line 206). Between lines 207 and 242, Z_B explained the increase in model and in prediction capability in order to facilitate understanding of H_A.M_G asked if overall percentage must be compared in classification table (line 243). Z_B responded that they made comparisons for overall percentage in step1 and baseline model (line 244). M_G stated that 1st classification table shows baseline hence they can see increase in percentage (line 245, 246). In addition, he offered to consider two table and report the comparison (line 248). These messages demonstrated the *idea connection* phase, since they are provided according to explanations of Z_B. H_A shared the related book page and proposed that they can compare in terms of S.E. By considering the resource, he interpreted that since S.E decreases, it fits and predicts better (line 249 -254), which are considered in *idea generation* phase. After this interpretation, M_G offered to report results belong to both methods and others agreed.

Question d

The question d has the following statement: Is/are the predictor variable(s) making a significant contribution to the prediction of the outcome? Why or why not?

As the solution of question d, Z_B proposed to consider wald or r statistic. Then, she stated that the variables in equation table in step 1 provides coefficients, and significance value shows that it is statistically significant at <.001. Therefore, she interpreted that it makes a significant contribution. H_A agreed on this interpretation and stated that it makes positive contribution for age parameter since exp(b) is bigger than 1. Z_B agreed on considering only age predictor.

H_A offered to provide explanations for all parameters in iii. As the interpretation, Z_B was not sure but suggested that it is significant for age but not for others. H_A stated that odds ratio is more than 1 for age, hence interpreted that age affects ratio positively but not too much. H_A stated he found exp(b) as 1.021, and M_G had the same value. Since Z_B's value is different than the others, she decided to reapply the test.

Z_B asked dependent and covariates. H_A responded that he didn't consider categorical variables. Z_B stated odd ratio as exp(b), and H_A agreed.

Line	Date	Post Time	Chat Message
260	11/24/2013	12:49 PM	H_A: question d?
261	11/24/2013	12:50 PM	Z_B: as far as I understood
262	11/24/2013	12:51 PM	Z_B: we should see Wald-statistics or calculate R-statistics
263	11/24/2013	12:51 PM	M_G: :)))
264	11/24/2013	12:51 PM	Z_B: :)
265	11/24/2013	12:52 PM	Z_B: the variables in equation table in step 1 gives us coefficients, and Sig. shows that it is statistically significant at <.001
266	11/24/2013	12:53 PM	Z_B: so we can say it makes a significant contribution
267	11/24/2013	12:53 PM	H_A: yes
268	11/24/2013	12:54 PM	H_A: since exp(b)>1
269	11/24/2013	12:54 PM	H_A: it makes positive contribution
270	11/24/2013	12:54 PM	H_A: for age parameter
271	11/24/2013	12:55 PM	Z_B: yes what i said was also only for age predictor
272	11/24/2013	12:55 PM	H_A: for iii) we will have to explain for all parameters
273	11/24/2013	12:56 PM	H_A: e?
274	11/24/2013	12:56 PM	Z_B: right
275	11/24/2013	1:01 PM	Z_B: did you do it for iii, it seems significant for the others, too. but it does not seem so for age, maybe i did something wrong.
276	11/24/2013	1:01 PM	H_A: odds ratio is exp(b)
277	11/24/2013	1:01 PM	H_A: it gives the affect ratio
278	11/24/2013	1:02 PM	H_A: it gives for i) and ii) also
279	11/24/2013	1:02 PM	H_A: i guess
280	11/24/2013	1:02 PM	H_A: for age it is >1
281	11/24/2013	1:02 PM	H_A: this means age affects the ratio positively but not too much
282	11/24/2013	1:03 PM	H_A: 1.021 is not a bit multiplier
283	11/24/2013	1:03 PM	H_A: bit=big
284	11/24/2013	1:03 PM	H_A: am i right?
285	11/24/2013	1:06 PM	Z_B: I did not understand the value 1.021?
286	11/24/2013	1:08 PM	Z_B: which table did you look at?
287	11/24/2013	1:08 PM	H_A: exp(b)
288	11/24/2013	1:08 PM	H_A: variables in the equation in block 1 for age
289	11/24/2013	1:08 PM	Z_B: it is 1.001 in mine

290	11/24/2013	1:08 PM	H_A: ??
291	11/24/2013	1:09 PM	Z_B: ok let me try it once again
292	11/24/2013	1:09 PM	H_A: what is b
293	11/24/2013	1:09 PM	H_A: M_G yours?
294	11/24/2013	1:09 PM	Z_B: 0.001
295	11/24/2013	1:09 PM	H_A: 0.021
296	11/24/2013	1:09 PM	Z_B: ok there is something wrong
297	11/24/2013	1:09 PM	Z_B: i ll try again
298	11/24/2013	1:10 PM	M_G: i will come back
299	11/24/2013	1:10 PM	M_G: i have to go for around 30 min
300	11/24/2013	1:10 PM	H_A: could you please write the exp(b) M_G
301	11/24/2013	1:10 PM	H_A: ?
302	11/24/2013	1:11 PM	M_G: for block 1 in variable equation?
303	11/24/2013	1:11 PM	H_A: yes
304	11/24/2013	1:11 PM	M_G: 1.021
305	11/24/2013	1:11 PM	M_G: 0.443
306	11/24/2013	1:11 PM	H_A: ok thanks
307	11/24/2013	1:11 PM	H_A: same
308	11/24/2013	1:12 PM	H_A: Z_B the spss has a problem i guess
309	11/24/2013	1:12 PM	Z_B: did you determine categorical covariates? maybe, i don't know.
310	11/24/2013	1:12 PM	H_A: in your pc
311	11/24/2013	1:12 PM	H_A: we encountered before.
312	11/24/2013	1:12 PM	H_A: remember?
313	11/24/2013	1:13 PM	Z_B: could you please tell me what you put for dependent variable and covariates.
314	11/24/2013	1:13 PM	H_A: categorical covariates?
315	11/24/2013	1:13 PM	H_A: i did nothing for categorical variables
316	11/24/2013	1:14 PM	H_A: dependent is vote
317	11/24/2013	1:14 PM	H_A: independent is age
318	11/24/2013	1:14 PM	H_A: no categorical selection done while analyzing
319	11/24/2013	1:14 PM	H_A: on spss
320	11/24/2013	1:14 PM	H_A: did you do?
321	11/24/2013	1:14 PM	Z_B: ok ok
322	11/24/2013	1:15 PM	Z_B: you are talking i)
323	11/24/2013	1:15 PM	Z_B: I was talking about iii
324	11/24/2013	1:15 PM	Z_B: for age I did not do any categorical change, either.
325	11/24/2013	1:15 PM	H_A: yes
326	11/24/2013	1:15 PM	H_A: :)
327	11/24/2013	1:16 PM	Z_B: now I understood
328	11/24/2013	1:16 PM	H_A: ok

329	11/24/2013	1:16 PM	Z_B: odds ratio is easy as you said
330	11/24/2013	1:16 PM	Z_B: it is exp(B)
331	11/24/2013	1:16 PM	H_A: yes
332	11/24/2013	1:17 PM	H_A: and it affects the change of vote according to the age?
333	11/24/2013	1:17 PM	H_A: i guess
334	11/24/2013	1:17 PM	H_A: since it is 1.021
335	11/24/2013	1:17 PM	H_A: there is no great affect
336	11/24/2013	1:17 PM	H_A: has positive affect but less
337	11/24/2013	1:17 PM	H_A: let me do it for iii)
338	11/24/2013	1:18 PM	H_A: yes i did for iii)
339	11/24/2013	1:18 PM	H_A: there is 24 for statusquo
340	11/24/2013	1:18 PM	Z_B: yes because it is greater than 1
341	11/24/2013	1:18 PM	H_A: and 1.7 for gender
342	11/24/2013	1:19 PM	H_A: according them we can say that it has no great affect
343	11/24/2013	1:19 PM	H_A: has small positive affect which may be neglected
344	11/24/2013	1:20 PM	H_A: btw i have 1.002 of age for iii)
345	11/24/2013	1:21 PM	Z_B: yes without doing any categorical selection, i found it too
346	11/24/2013	1:21 PM	Z_B: but don't we need to identify it for those variables which are categorical?
347	11/24/2013	1:21 PM	Z_B: like gender?
348	11/24/2013	1:22 PM	H_A: how?
349	11/24/2013	1:23 PM	Z_B: see page 279 please
350	11/24/2013	1:25 PM	H_A: yes i see
351	11/24/2013	1:25 PM	H_A: why do we have to do
352	11/24/2013	1:30 PM	H_A: yes i agree
353	11/24/2013	1:28 PM	Z_B: maybe to determine which category we are going to use as our baseline?
354	11/24/2013	1:28 PM	Z_B: I didn't understand much too, but this seems the only reason.
355	11/24/2013	1:29 PM	Z_B: if we don't choose, does it use any one of them as the baseline, so maybe there may not be a problem :S
356	11/24/2013	1:29 PM	Z_B: i could not be sure
357	11/24/2013	1:31 PM	H_A: but choosing a category, there will be lots of choice
358	11/24/2013	1:31 PM	H_A: and there is no mention in the hw about categorical regression
359	11/24/2013	1:36 PM	H_A: ??
360	11/24/2013	1:39 PM	Z_B: I don't know if we need to do it, yes there will be other comparisons in the outcome which maybe we don't need to comment on
361	11/24/2013	1:39 PM	Z_B: if you say it will be fine we can move
362	11/24/2013	1:40 PM	Z_B: in the lesson i remember we did those selection, and in the book it says we need to tell, that's why I am confused
363	11/24/2013	1:40 PM	Z_B: lets compare both cases

364	11/24/2013	1:40 PM	Z_B: if it is ok
365	11/24/2013	1:41 PM	Z_B: ???
366	11/24/2013	1:42 PM	H_A: ok lets do
367	11/24/2013	1:42 PM	H_A: you think we have to choose gender?
368	11/24/2013	1:42 PM	H_A: or statusquo
369	11/24/2013	1:43 PM	Z_B: gender and education
370	11/24/2013	1:43 PM	Z_B: probably status quo too
371	11/24/2013	1:44 PM	H_A: when i choose gender
372	11/24/2013	1:44 PM	H_A: 92.7 predicted
373	11/24/2013	1:45 PM	H_A: exp(B) does not change for age and income
374	11/24/2013	1:45 PM	H_A: but constant change
375	11/24/2013	1:45 PM	Z_B: yes, because the baseline changes
376	11/24/2013	1:46 PM	Z_B: my spss froze :S
377	11/24/2013	1:46 PM	H_A: yes
378	11/24/2013	1:46 PM	H_A: mine too
379	11/24/2013	1:46 PM	H_A: while doing f or statusquo
380	11/24/2013	1:52 PM	H_A: are you there?
381	11/24/2013	1:53 PM	Z_B: i am trying to work my spss
382	11/24/2013	1:54 PM	H_A: spss now working for statusquo???
383	11/24/2013	1:54 PM	H_A: strange
384	11/24/2013	1:54 PM	H_A: others worked
385	11/24/2013	1:55 PM	Z_B: yes
386	11/24/2013	1:56 PM	Z_B: what does -1,0,1,2 mean for status quo?
387	11/24/2013	2:00 PM	Z_B: maybe we should move on
388	11/24/2013	2:00 PM	H_A: strange...
389	11/24/2013	2:00 PM	H_A: it does not work for statusquo
390	11/24/2013	2:00 PM	Z_B: i will search about it
391	11/24/2013	2:00 PM	Z_B: yes :(
392	11/24/2013	2:00 PM	H_A: it waits
393	11/24/2013	2:00 PM	H_A: then what is statusquo?
394	11/24/2013	2:01 PM	H_A: i don't know the meaning btw
395	11/24/2013	2:01 PM	Z_B: yes that's my question
396	11/24/2013	2:01 PM	H_A: :)
397	11/24/2013	2:02 PM	H_A: http://en.wikipedia.org/wiki/Status_quo
398	11/24/2013	2:04 PM	Z_B: so, -1, 0, 1 and 2 are the rates/level of support for the current government???
399	11/24/2013	2:04 PM	H_A: don't think so
400	11/24/2013	2:04 PM	H_A: i think no matter
401	11/24/2013	2:04 PM	H_A: it doesn't affect the homework:)
402	11/24/2013	2:08 PM	Z_B: ok, it does not work, either
403	11/24/2013	2:08 PM	H_A: yes

Analysis of the messages between lines 260 and 403 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. Z_B offered to consider wald or r statistic (line 262). Next, she stated that the variables in equation table in step 1 gives coefficients, and significance value demonstrates that it is statistically significant at <.001 (line 265). Hence, she interpreted that predictor makes a significant contribution (line 266). Suggestions of Z_B demonstrated the *idea generation* phase. Between lines 267 and 270, H_A agreed with the offers of Z_B and interpreted the positive contribution of age predictor. These messages are considered in *idea connection* phase since there is comparison and agreement.

H_A suggested providing explanations related to contributions of all parameters in iii (line 272). As the solution, Z_B offered that it is significant for age but not for others (line 275), which is considered in *idea generation* phase. H_A stated that odds ratio is more than 1 for age, hence interpreted that age affects ratio positively but not too much (line 276-283), which demonstrated the *idea generation* phase. H_A stated he found exp(b) as 1.021, and M_G had the same value. Z_B recognized that she found the value different from the others, hence she decided to reapply the test (line 297). Since members compared their findings in these messages they are considered in *idea connection* phase. Between lines 309 and 403, Z_B asked the steps of analysis and H_A provided related explanations.

Question e

The question e has the following statement: What is the odds ratio value in this model? What does it tell you about the model (i.e. provide a verbal description of what it implies about the data)?

Z_B stated that they previously mentioned question e by considering exp(b). Similarly, H_A stated that they need to explain exp(b), and interpreted that age has no affect on vote since it is near to 1. Then, he explained that exp(b) means affect size and is obtained from b. In addition, he provided the calculation of exp (b).

H_A explained that s.e means standard deviation since it is small fit to the model.

Providing Results of Question e

Members have different ideas about the results they should provide. For M_G, they need to provide exp(B) and mean. For H_A, they need to provide wald and df. For Z_B, it is enough to comment on exp(B).

Z_B firstly defined the odds ratio as the division of the probability of occurring to probability of not occurring. Then, she provided a detailed explanation that if the value is more than 1, the predictor increases as the odds of outcome occurring increase; if the value is less than 1, the predictor decreases as the odds of outcome occurring increase. Others agreed on these explanations.

Line	Date	Post Time	Chat Message
433	11/25/2013	11:58 AM	Z_B: actually we mentioned about e
434	11/25/2013	11:58 AM	Z_B: a bit
435	11/25/2013	11:58 AM	Z_B: it is exp(B)
436	11/25/2013	11:59 AM	H_A: yes
437	11/25/2013	11:59 AM	H_A: i think we have to explain
438	11/25/2013	11:59 AM	H_A: since exp(b) is near to 1
439	11/25/2013	11:59 AM	H_A: age has no great affect on vote
440	11/25/2013	11:59 AM	H_A: result
441	11/25/2013	12:00 PM	H_A: since exp(b) means affect size
442	11/25/2013	12:00 PM	H_A: which is obtained from B
443	11/25/2013	12:01 PM	H_A: 2.78^0.021=1.021
444	11/25/2013	12:01 PM	H_A: i calculated just a second ago
445	11/25/2013	12:02 PM	H_A: s.e means standard deviation
446	11/25/2013	12:02 PM	H_A: since it is small it fits to the model
447	11/25/2013	12:02 PM	M_G: from "variable in the equation" table
448	11/25/2013	12:02 PM	H_A: sig=000 means it has normal distribution
449	11/25/2013	12:02 PM	M_G: we can find exp(B)
450	11/25/2013	12:02 PM	H_A: then we have to explain wald and df
451	11/25/2013	12:03 PM	M_G: i think we need to explain what is mean
452	11/25/2013	12:03 PM	Z_B: H_A for e?
453	11/25/2013	12:04 PM	Z_B: I think it is enough to comment on exp(B). right? odds ratio means the division of the probability of occuring to probability of not occurring
454	11/25/2013	12:03 PM	H_A: yes
455	11/25/2013	12:03 PM	H_A: for e for age
456	11/25/2013	12:05 PM	Z_B: and if the value is greater than 1 then it says as the predictor increases the odds of the outcome occuring increase.
457	11/25/2013	12:05 PM	Z_B: and when it is less than 1, as the predictor increases, the odds of the outcome occuring decrease
458	11/25/2013	12:05 PM	H_A: yes
459	11/25/2013	12:05 PM	H_A: then it is ok
460	11/25/2013	12:05 PM	M_G: yes, it is ok
461	11/25/2013	12:05 PM	Z_B: yes
462	11/25/2013	12:05 PM	Z_B: i think such an explanation for the results would be enough
463	11/25/2013	12:05 PM	H_A: exactly

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 433 and 463 can be analyzed as follows. Between lines 437 and 446, H_A provided the results related to exp(b), which are considered in *idea generation* phase.

Z_B offered to interpret exp(b) and defined the odds ratio as the division of the probability of occurring to probability of not occurring (453). Then, she provided a detailed explanation of odds ratio (line 456, 457). These explanations demonstrated the *idea generation*. Others agreed on these explanations.

Question-f

The question f has the following statement: Does the confidence interval of a predictor in the model include the value 1? What would be the issue if the confidence interval includes 1?

Interpretation

M_G stated that the model doesn't include value 1 because of lower and upper values. Therefore, Z_B interpreted that it is good because it doesn't include 1, and the odds for two variables are different. If 1 is included, data don't provide enough information to make interpretations about variables. Based on slide explanation, M_G explained that if confidence interval (CI) included 1, it would be harder to interpret relation between predictor and the probability of the outcome since it can be in either direction.

CI value

H_A asked the interpretation if there is lack of 1 in the model. As a response, Z_B explained that lack of 1 means there is no association.

H_A stated that he didn't find CI value. Z_B offered that they should consider CI for exp(b) and provided the steps of listing ci for exp (b).

M_G reported that ci value is 95% for exp(b), and reported lower and upper values. Z_B provided confirmation to the results.

H_A expected to understand that if the lack of 1 means there is no association. However, Z_B indicated the reverse. She explained that if it includes 1, there is no association.

H_A didn't know about ci, others explained. Therefore, he could find ci and interpret the results correctly.

Line	Date	Post Time	Chat Message
464	11/25/2013	12:06 PM	H_A: f?
465	11/25/2013	12:06 PM	H_A: yes agreed
466	11/25/2013	12:08 PM	H_A: confidence interval explain in page 43
467	11/25/2013	12:15 PM	H_A: are you there?
468	11/25/2013	12:15 PM	M_G: yes
469	11/25/2013	12:15 PM	H_A: did you read p.43
470	11/25/2013	12:15 PM	H_A: i got the point
471	11/25/2013	12:16 PM	M_G: according to the page 45, the model does not include the value 1
472	11/25/2013	12:16 PM	M_G: because of the lower and upper value
473	11/25/2013	12:16 PM	M_G: is it ok?

474	11/25/2013	12:19 PM	Z_B: then we can say that it is good because if it does not include 1, it means we can conclude that the odds for the two variables are different, if it included, it would mean the data do not provide enough evidence to say sth about the variables. If I am not wrong,,
475	11/25/2013	12:21 PM	M_G: in slide 39(add note part)
476	11/25/2013	12:21 PM	M_G: It is important that lower value is larger than one, if CI included 1 then it would be harder to interpret the relation between predictor and the probability of the outcome, because it can be in either direction at the population level
477	11/25/2013	12:22 PM	H_A: actually i did not understand what is happening
478	11/25/2013	12:22 PM	H_A: just a second
479	11/25/2013	12:22 PM	H_A: model does not include 1 means what, and how
480	11/25/2013	12:25 PM	Z_B: model does not include 1 means there is no association
481	11/25/2013	12:25 PM	H_A: where is the CI value, i don't have that one
482	11/25/2013	12:26 PM	Z_B: I think we look into this CI for exp (B)
483	11/25/2013	12:26 PM	Z_B: am I right M_G?
484	11/25/2013	12:26 PM	Z_B: ci is for confidence interval
485	11/25/2013	12:27 PM	Z_B: if it is above than 1
486	11/25/2013	12:27 PM	H_A: yes sure
487	11/25/2013	12:27 PM	H_A: but where is it
488	11/25/2013	12:27 PM	Z_B: it means positive association
489	11/25/2013	12:27 PM	Z_B: in variables in equation the last column, step1
490	11/25/2013	12:28 PM	H_A: you pointed exp(B)? Z_B
491	11/25/2013	12:29 PM	Z_B: no there is another column
492	11/25/2013	12:29 PM	M_G: 95% C.I.for EXP(B)
493	11/25/2013	12:29 PM	Z_B: by it
494	11/25/2013	12:29 PM	Z_B: maybe you don't see it if you did not check CI option
495	11/25/2013	12:29 PM	M_G: in variable in the equation
496	11/25/2013	12:29 PM	Z_B: before
497	11/25/2013	12:30 PM	M_G: Lower Upper 1.014 1.028
498	11/25/2013	12:30 PM	Z_B: see logistic regression> options> there is this 95% CI for exp(B)
499	11/25/2013	12:30 PM	M_G: for age
500	11/25/2013	12:31 PM	Z_B: yes M_G right
501	11/25/2013	12:32 PM	M_G: i) and ii) both have lower part bigger than 1
502	11/25/2013	12:32 PM	H_A: yes i see, thank you Z_B
503	11/25/2013	12:36 PM	M_G: i will come back 15 min later
504	11/25/2013	12:38 PM	H_A: Z_B look at this one
505	11/25/2013	12:39 PM	H_A: http://www.ats.ucla.edu/stat/spss/output/mlogit.htm
506	11/25/2013	12:39 PM	H_A: last paragraph is about CI
507	11/25/2013	12:43 PM	H_A: Z_B?
508	11/25/2013	12:45 PM	Z_B: I think we said the similar things

509	11/25/2013	12:45 PM	Z_B: in a simpler way
510	11/25/2013	12:45 PM	Z_B: "simpler"
511	11/25/2013	12:46 PM	Z_B: right?
512	11/25/2013	12:46 PM	Z_B: did u think something different is told here?
513	11/25/2013	12:46 PM	Z_B: maybe I could not notice
514	11/25/2013	12:48 PM	H_A: i agreed
515	11/25/2013	12:48 PM	H_A: i am collecting some materials
516	11/25/2013	12:48 PM	H_A: http://www.ats.ucla.edu/stat/spss/output/logistic.htm
517	11/25/2013	12:48 PM	H_A: here is another one
518	11/25/2013	12:49 PM	H_A: could you please read the last link
519	11/25/2013	12:50 PM	Z_B: ok
520	11/25/2013	12:50 PM	M_G: hi again
521	11/25/2013	12:51 PM	H_A: hi
522	11/25/2013	12:52 PM	Z_B: hi
523	11/25/2013	12:52 PM	Z_B: yes I read
524	11/25/2013	12:52 PM	Z_B: it
525	11/25/2013	12:53 PM	H_A: then you said doesn't include 1 means there is no association
526	11/25/2013	12:54 PM	H_A: ?
527	11/25/2013	12:54 PM	H_A: is it true?
528	11/25/2013	12:54 PM	Z_B: I think the opposite is the true
529	11/25/2013	12:54 PM	H_A: yes
530	11/25/2013	12:54 PM	H_A: if it does not include one then the exp(b) gives true information?
531	11/25/2013	12:54 PM	Z_B: if it includes 1, then no association, it is not worth commenting on it.
532	11/25/2013	12:54 PM	H_A: am i right?
533	11/25/2013	12:54 PM	Z_B: right
534	11/25/2013	12:55 PM	Z_B: for income, it is 1.000 right in iii), we need to comment on stuff carefully.
535	11/25/2013	12:55 PM	H_A: yes agreed
536	11/25/2013	1:00 PM	Z_B: are you there?
537	11/25/2013	1:00 PM	M_G: yes
538	11/25/2013	1:01 PM	M_G: i am reading the last link
539	11/25/2013	1:01 PM	Z_B: ok
540	11/25/2013	1:01 PM	Z_B: :)

Analysis of the messages between lines 464 and 540 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. M_G interpreted that the model doesn't consist of the value 1 because of lower and upper values (line 471, 472). These messages are considered in *idea generation* phase. Based on this interpretation, Z_B indicated that the model is good because it doesn't include 1, and the odds for two variables

are different (line 474). Since this message is based on the previous message, it demonstrated the *idea connection* phase. In terms of the slide explanation, M_G explained that if confidence interval (CI) included 1, it would be harder to interpret relation between predictor and the probability of the outcome (line 476). This message reflected the *idea improvement* since consists of a different example.

H_A expected to understand the interpretation if the model lacks the value 1 (479). As a response, Z_B explained that lack of 1 means there is no association (480). However, H_A stated that he didn't find CI value (481). Between lines 482 and 500, Z_B offered that they should consider CI for exp(b) and provided the steps of listing ci for exp (b).

Between lines 504 and 518, H_A shared links of two web sites for the interpretation of ci value. His attempts to learn about ci can be regarded as *idea improvement*. However, H_A thought that lack of 1 means there is no association (line 525). However, Z_B indicated the reverse. She explained that if it includes 1, there is no association (line 531). Comparisons and explanations related to different ideas demonstrated the *idea connection* phase.

Residuals

The question g has the following statement: Are the residuals normally distributed? Are there any influential cases? What do these tests imply about the predictive power of the model?

H_A didn't understand the question and asked the meaning of residual. As a response, Z_B offered to consider cook distance, and also review the slide and book content for obtaining residuals. For H_A, the residual is other than 95%, and out of the confidence interval.

M_G provided the example in the book and stated that the residual chi-sq statistic is 9.83. He additionally provided the interpretation that the significance means that coefficients for the variables not in model are significantly different from zero. Therefore, they are likely to improve the predictive power of the model.

They discussed about the analysis steps. H_A listed the steps and interpreted the results.

Line	Date	Post Time	Chat Message
542	11/25/2013	1:06 PM	H_A: then continue?
543	11/25/2013	1:06 PM	Z_B: ok
544	11/25/2013	1:06 PM	Z_B: residuals?
545	11/25/2013	1:08 PM	H_A: actually i didn't understand the question
546	11/25/2013	1:08 PM	H_A: what is residual
547	11/25/2013	1:10 PM	Z_B: as far as I understood, we need to look into cooks distance, etc. see "obtaining residuals" both in the ppt and book page 292, but I am not sure how we can explain whether it is normally distributed or not.
548	11/25/2013	1:09 PM	H_A: the thing i got
549	11/25/2013	1:09 PM	H_A: residual means other then %95
550	11/25/2013	1:09 PM	H_A: out of the confidence interval?
551	11/25/2013	1:09 PM	H_A: am i right?
552	11/25/2013	1:11 PM	M_G: slide 37(add note part)

553	11/25/2013	1:11 PM	M_G: Residual chi-square statistic is 9.83, and significant Tells us that coefficients for the variables not in the model are significantly different from zero, so they are likely to improve the predictive power of the model (if p>0.05 then this would not be the case)
554	11/25/2013	1:12 PM	M_G: Variables not in the Equation
555	11/25/2013	1:14 PM	M_G: page 284
556	11/25/2013	1:14 PM	M_G: If the probability for the residual chi-square had been greater than .05 it would have meant that forcing all of the variables excluded from the model into the model would not have made a significant contribution to its predictive power.
557	11/25/2013	1:18 PM	M_G: are you there?
558	11/25/2013	1:20 PM	Z_B: yes I m trying to understand
559	11/25/2013	1:27 PM	H_A: M_G how did you find 9.83
560	11/25/2013	1:28 PM	M_G: 9.83 is in slides, i don't find it :))
561	11/25/2013	1:28 PM	M_G: i just copy paste it here
562	11/25/2013	1:29 PM	M_G: in our case is 41.078
563	11/25/2013	1:30 PM	H_A: sorry but I don’t understand
564	11/25/2013	1:30 PM	H_A: where we are
565	11/25/2013	1:30 PM	H_A: or what is our methodology
566	11/25/2013	1:30 PM	H_A: the thing i understand is the residual is remaining part of the %95
567	11/25/2013	1:30 PM	M_G: according to the slide, residual in age, 41.078
568	11/25/2013	1:31 PM	H_A: then?
569	11/25/2013	1:31 PM	H_A: to find the normal distribution of residuals
570	11/25/2013	1:31 PM	H_A: we have to find the data list
571	11/25/2013	1:31 PM	H_A: and take mean of them
572	11/25/2013	1:32 PM	H_A: am i right?
573	11/25/2013	1:32 PM	M_G: i don’t understand normal distribution
574	11/25/2013	1:32 PM	Z_B: me too
575	11/25/2013	1:34 PM	H_A: i think i found something
576	11/25/2013	1:34 PM	H_A: please do regression>linear distribution according to the age
577	11/25/2013	1:34 PM	H_A: age is independent variable
578	11/25/2013	1:34 PM	H_A: vote is dependent variable
579	11/25/2013	1:35 PM	H_A: you will see some tables
580	11/25/2013	1:35 PM	H_A: residuals and their mean
581	11/25/2013	1:35 PM	H_A: i think this is the solution
582	11/25/2013	1:35 PM	H_A: i watch a video on that
583	11/25/2013	1:36 PM	H_A: did you do steps i described
584	11/25/2013	1:37 PM	Z_B: yes
585	11/25/2013	1:37 PM	M_G: yes
586	11/25/2013	1:37 PM	H_A: does it give you some info?

587	11/25/2013	1:37 PM	H_A: residual statistics
588	11/25/2013	1:38 PM	H_A: ?
589	11/25/2013	1:38 PM	H_A: mean is zero
590	11/25/2013	1:40 PM	H_A: select the histogram also
591	11/25/2013	1:43 PM	M_G: but we have to solve it in logistic regression, not in linear regression
592	11/25/2013	1:44 PM	Z_B: right
593	11/25/2013	1:51 PM	H_A: hey friends!
594	11/25/2013	1:51 PM	H_A: please look at slide 33
595	11/25/2013	1:51 PM	H_A: and 34
596	11/25/2013	1:51 PM	H_A: execute them
597	11/25/2013	1:51 PM	H_A: then you will have new variables
598	11/25/2013	1:51 PM	H_A: names as PRE_1 PGR_1 and etc
599	11/25/2013	1:52 PM	H_A: i think this is the way we have to go into
600	11/25/2013	1:52 PM	H_A: all you done?
601	11/25/2013	1:54 PM	M_G: yes
602	11/25/2013	1:55 PM	Z_B: yes definitely agree we need to follow slide 33
603	11/25/2013	1:55 PM	Z_B: I was reading the book about how to comment on it
604	11/25/2013	1:55 PM	Z_B: how to do it
605	11/25/2013	1:55 PM	Z_B: we need cooks distance
606	11/25/2013	1:55 PM	Z_B: to find a case influencing the model
607	11/25/2013	1:56 PM	Z_B: we can find them by going report> case summaries and clicking on variable cooks distance
608	11/25/2013	1:57 PM	Z_B: after we did the analysis of course, checking the cooks distance,etc.
609	11/25/2013	1:57 PM	H_A: yes
610	11/25/2013	1:57 PM	H_A: i had read something like that but could not understand
611	11/25/2013	1:57 PM	H_A: now we have cooks distance
612	11/25/2013	1:58 PM	Z_B: see page 245
613	11/25/2013	2:00 PM	Z_B: we can also look into DFBeta statistics
614	11/25/2013	2:00 PM	Z_B: "We can look also at the DFBeta statistics to see whether any case would have a large influence on the regression parameters. An absolute value greater than 1 is a problem"
615	11/25/2013	2:03 PM	Z_B: we need to hurry up :(
616	11/25/2013	2:04 PM	M_G: i cant understand this part and cooks distance :(
617	11/25/2013	2:05 PM	Z_B: I am not very clear, either
618	11/25/2013	2:05 PM	Z_B: the only thing I saw is that the book leads us to them in order to obtain residuals.
619	11/25/2013	2:06 PM	Z_B: and on page 245 it is explained how to comment on them.
620	11/25/2013	2:08 PM	H_A: friends
621	11/25/2013	2:08 PM	H_A: !
622	11/25/2013	2:08 PM	H_A: ZRE_1 is our residuals
623	11/25/2013	2:08 PM	H_A: we have to test for normality

624	11/25/2013	2:08 PM	H_A: for ZRE_1
625	11/25/2013	2:09 PM	Z_B: hmm makes sense
626	11/25/2013	2:10 PM	H_A: it is normally distributed
627	11/25/2013	2:10 PM	H_A: as we done in hw1
628	11/25/2013	2:10 PM	H_A: please choose zre_1 for analyze>D.S>explore
629	11/25/2013	2:10 PM	H_A: then see the normality test table
630	11/25/2013	2:14 PM	H_A: are you there?
631	11/25/2013	2:14 PM	M_G: yrs
632	11/25/2013	2:14 PM	Z_B: yep
633	11/25/2013	2:15 PM	M_G: now we have to put this table as a result?
634	11/25/2013	2:16 PM	H_A: yes
635	11/25/2013	2:16 PM	H_A: and the question Are there any influential cases?
636	11/25/2013	2:16 PM	H_A: "Are there any influential cases? "
637	11/25/2013	2:16 PM	H_A: what is this
638	11/25/2013	2:17 PM	M_G: i don't know :(
639	11/25/2013	2:20 PM	Z_B: if we look into cooks and dbfbeta, none of them are greater than 1, the cases lie within +/- one, there is no undue / problematic influence
640	11/25/2013	2:19 PM	H_A: http://case.truman.edu/Documents/Minitab%20Residuals%20and%20Influential%20Points.pdf
641	11/25/2013	2:19 PM	H_A: this link says that influential cases are outliers
642	11/25/2013	2:20 PM	H_A: i will come back after 5 min
643	11/25/2013	2:20 PM	Z_B: that's what I see :(
644	11/25/2013	2:23 PM	H_A: are you agree on what i wrote?
645	11/25/2013	2:24 PM	H_A: did you look at the pdf?
646	11/25/2013	2:25 PM	Z_B: Ill now, give me a second
647	11/25/2013	2:32 PM	Z_B: ok makes sense
648	11/25/2013	2:34 PM	H_A: yes residual means %5 part of the data
649	11/25/2013	2:34 PM	H_A: means outliers
650	11/25/2013	2:34 PM	H_A: we can plot the outliers as before
651	11/25/2013	2:35 PM	H_A: "Many of these points are considered outliers, which have large residual values"
652	11/25/2013	2:36 PM	H_A: more residual value means more influential value
653	11/25/2013	2:36 PM	H_A: then we have to look at the most biggest value of residual
654	11/25/2013	2:37 PM	H_A: and there is no big residual, so no influential cases?
655	11/25/2013	2:37 PM	H_A: am i right?
656	11/25/2013	2:38 PM	H_A: you can look at the histogram of residual
657	11/25/2013	2:38 PM	H_A: there are between -1.5 and 1.3
658	11/25/2013	2:38 PM	H_A: and normally distributed
659	11/25/2013	2:38 PM	H_A: Z_B??
660	11/25/2013	2:38 PM	M_G: yes

661	11/25/2013	2:39 PM	Z_B: right
662	11/25/2013	2:43 PM	M_G: i will come back
663	11/25/2013	2:43 PM	H_A: i think we are ok at this question
664	11/25/2013	2:45 PM	Z_B: yes

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 542 and 664 can be analyzed as follows. In line 546, H_A asked the meaning of residual. Z_B offered to consider cook distance to identify residuals (line 547), which demonstrated the *idea generation* phase. According to H_A, residual refers other than 95%, and out of the confidence interval (line 549, 550), which is considered in *idea generation* phase. By considering the book content, M_G provided examples and interpretations about the interpretation of chi-square, which demonstrated the *idea connection* phase (lines 552-556).

Between lines 575 and 581, H_A listed the steps of checking normality of residuals, which reflect the *idea generation* phase. Although H_A offered the linear regression, M_G suggested to apply logistic regression (line 591), which is also considered in *idea generation* phase. Between lines 594 and 600, H_A listed the steps of analysis based on course slides, which illustrated the *idea connection* phase. Other members agreed on the steps (line 601, 602). Between lines 603 and 614, Z_B provided explanations for the interpretation of residuals. In lines 620 and 634 indicated the residuals and their normality test, which demonstrated the *idea generation* phase.

H_A and M_G had lack of knowledge about the influential cases (637, 638). For the explanation, H_A provided a web source and interpreted that influential cases refer outliers (640, 641), which can be considered in *idea connection* phase. Between lines 648 and 658, H_A provided the interpretations for the question, which illustrated the *idea generation* phase.

ASSIGNMENT-7

A researcher is interested in identifying how psychology majors' knowledge of different aspects of psychology improved throughout the first three years of their undergraduate education. The experimenter took a sample of first, second and third year students and gave them five multiple choice tests (maximum possible score was 15 for each test) representing core areas in psychology: Statistics, Experimental Psychology, Social Psychology, Developmental Psychology and Psychiatry. The dataset for this study is in PsychUndergrads.sav

Multivariate Test

The question c has the following statement: What can you conclude from the Multivariate Tests table? Is there an experimental effect? (Provide the test results table, state which test you picked and why)

For question c, H_A interpreted that they are all significant ($p < .05$), so concluded that year has affect on all 5 groups. Others agreed.

Z_B asked the test they should apply. For her, pillai test is the best option since Pillai is said to be more robust to the violations of assumptions when sample sizes are not equal. Related to the selection of Pillai, H_A provided explanations from a resource and Z_B again confirmed the selection of Pillai.

Line	Date	Post Time	Chat Message
266	1/9/2014	3:51 PM	Z_B: ok, c.
267	1/9/2014	3:52 PM	H_A: they are all significant (p < .05), so we can conclude that year has affect on all 5 groups
268	1/9/2014	3:53 PM	H_A: v
269	1/9/2014	3:53 PM	H_A: above comment is for question -c
270	1/9/2014	3:53 PM	H_A: p<0.05
271	1/9/2014	3:53 PM	H_A: for all 4 test
272	1/9/2014	3:54 PM	H_A: therefore year has great affect on DV
273	1/9/2014	3:54 PM	Z_B: right
274	1/9/2014	3:54 PM	H_A: s
275	1/9/2014	3:54 PM	M_G: yes
276	1/9/2014	3:54 PM	Z_B: and which test should we use?
277	1/9/2014	3:54 PM	Z_B: which test we picked and why?
278	1/9/2014	3:55 PM	Z_B: Actually, it says for small or medium size samples 4 tests do not differ much Pillai's is one option to focus
279	1/9/2014	3:55 PM	M_G: for all of them p<0.05
280	1/9/2014	3:55 PM	Z_B: right
281	1/9/2014	3:56 PM	Z_B: Pillai is said to be more robust to the violations of assumptions when sample sizes are not equal
282	1/9/2014	3:56 PM	H_A: actually i watched youtube videos
283	1/9/2014	3:56 PM	H_A: they always choose that one
284	1/9/2014	3:56 PM	H_A: hmmm
285	1/9/2014	3:57 PM	Z_B: because we have 11 for first year 16 for another, and 13 for another,
286	1/9/2014	3:57 PM	Z_B: that may be our explanation...
287	1/9/2014	3:57 PM	Z_B: what do you say?
288	1/9/2014	4:01 PM	H_A: Multivariate Measures: In most of the statistical programs used to calculate MANOVAs there are four multivariate measures: Wilks'lambda, Pillai's trace, Hotelling-Lawley trace and Roy's largest root. The difference between the four measures is the way in which they combine the dependent variables in order examine the amount of variance in the data. Wilks' lambda demonstrates the amount of variance accounted for in the dependent variable by the independent variable; the smaller the value, the larger the difference between the groups being analyzed. 1 minus Wilks' lambda indicates the amount of variance in the dependent variables accounted for by the independent variables. Pillai's trace is considered the most

			reliable of the multivariate measures and offers the greatest protection against Type I errors with small sample sizes. Pillai's trace is the sum of the variance which can be explained by the calculation of discriminant variables. It calculates the amount of variance in the dependent variable which is accounted for by the greatest separation of the independent variables. The Hotelling-Lawley trace is generally 2 - Manova 4.3.05 35 converted to the Hotelling's T-square. Hotelling's T is used when the independent variable forms two groups and represents the most significant linear combination of the dependent variables. Roy's largest root, also known as Roy's largest eigenvalue, is calculated in a similar fashion to Pillai's trace except it only considers the largest eigenvalue (i.e. the largest loading onto a vector) . As the sample sizes increase the values produced by Pillai's trace, Hotelling-Lawley trace and Roy's largest root become similar. As you may be able to tell from these very broad explanations, the Wilks' lambda is the easiest to understand and therefore the most frequently used measure. Multivariate F value: This is similar to the univariate F value in that it is representative of the degree of difference in the dependent variable created by the independent variable. However, as well as being based on the sum of squares (as in ANOVA) the calculation for F used in MANOVAs also takes into account the covariance of the variables.
289	1/9/2014	4:01 PM	H_A: could you please read above comment
290	1/9/2014	4:03 PM	H_A: did you read?
291	1/9/2014	4:03 PM	H_A: i may send file
292	1/9/2014	4:03 PM	Z_B: ok I read
293	1/9/2014	4:03 PM	Z_B: it seems pillai is the best option
294	1/9/2014	4:03 PM	H_A: yes
295	1/9/2014	4:03 PM	H_A: i looked at the type I error
296	1/9/2014	4:03 PM	H_A: there is one exception for normality
297	1/9/2014	4:04 PM	H_A: this may reject the null hyphothesis
298	1/9/2014	4:04 PM	H_A: to protect from it, we may use it?
299	1/9/2014	4:04 PM	H_A: i don't know i am right or not?
300	1/9/2014	4:04 PM	Z_B: I think so
301	1/9/2014	4:04 PM	H_A: ok well

In terms of the Progressive Knowledge Building Inquiry cycle, messages between lines 266 and 301 can be analyzed as follows. Between lines 267 and 272, H_A interpreted the significant scores, so concluded that year has affect on all 5 groups, which demonstrated the *idea generation* phase. Other members agreed on these interpretations (273, 275). Z_B asked the test they should apply (276, 277). According to Z_B, pillai test is the best choice since Pillai it is more robust to the violations of assumptions when sample sizes are not equal (281), which demonstrated the *idea generation* phase. For the selection of Pillai, H_A provided detailed explanations from a resource (line 288), which is considered *idea connection* phase. Z_B confirmed the selection of Pillai (293).

Anova

The question d has the following statement: Also conduct individual ANOVA test(s) for the dependent variable(s). What can you deduce from individual ANOVA tests regarding the differences among student groups across topics? Given the results for each dependent variable, does it make sense to conduct contrasts or post-hoc tests? If so, report the results of follow up tests.

The team decided to apply anova for each dependent variable. Z_B sent the results and interpreted that there is difference between groups. However, she wasn't sure about the interpretation. H_A checked the results and presented the same reasoning as Z_B. Based on previous homework, he interpreted that "The variance of the difference between groups are not equal since p(0.017)<0.05 in the Mauchly's test of sphericity. Therefore the assumptions are not satisfied." On the other hand, Z_B disagreed with the p value offered by H_A. She stated that the p value is not smaller than 0.05, hence concluded that there is not difference between groups.

H_A offered that they can apply mauchy or sphericity test but wasn't sure enough. Z_B explained that the anova is the correct to be applied for each dependent variable. In addition, she offered the post hoc or contrast tests based on anova results.

H_A applied sphericity test in order to understand differences between groups and interpreted that there is no differences between groups where year is with in subject. On the other hand, Z_B suggested that one way Anova result provides this result as well.

Z_B offered to apply anova for individual dependent variables and H_A stated that there will be five anova results.

H_A and M_G didn't know about post hoc and contrast tests. Then, Z_B explained and H_A also found a resource.

Line	Date	Post Time	Chat Message
325	1/9/2014	4:12 PM	H_A: then d?
326	1/9/2014	4:13 PM	M_G: tomorrow??
327	1/9/2014	4:13 PM	H_A: do we do anova for each dependent?
328	1/9/2014	4:13 PM	Z_B: yes we need to do, the question says so
329	1/9/2014	4:13 PM	H_A: hmm
330	1/9/2014	4:13 PM	H_A: lets do
331	1/9/2014	4:14 PM	Z_B: ok
332	1/9/2014	4:15 PM	Z_B: H_A
333	1/9/2014	4:15 PM	Z_B: if you like
334	1/9/2014	4:15 PM	Z_B: if you did not have the outputs
335	1/9/2014	4:15 PM	Z_B: I can send them to you
336	1/9/2014	4:15 PM	Z_B: and we can just discuss about them
337	1/9/2014	4:16 PM	H_A: i am producing
338	1/9/2014	4:16 PM	H_A: but you can
339	1/9/2014	4:16 PM	H_A: it will be faster

340	1/9/2014	4:16 PM	M_G: send me
341	1/9/2014	4:16 PM	Z_B: yes
342	1/9/2014	4:16 PM	M_G: i put it in wiki
343	1/9/2014	4:17 PM	Z_B: I sent the outputs for individuals ANOVA
344	1/9/2014	4:18 PM	M_G: ok
345	1/9/2014	4:18 PM	M_G: i will put them
346	1/9/2014	4:18 PM	Z_B: you will see that none of them are significant
347	1/9/2014	4:20 PM	Z_B: so can we say that groups are different from each other across years?
348	1/9/2014	4:21 PM	Z_B: or actually just the opposite
349	1/9/2014	4:21 PM	H_A: let me a second
350	1/9/2014	4:21 PM	Z_B: ok
351	1/9/2014	4:22 PM	H_A: i looked at the previous hw
352	1/9/2014	4:22 PM	H_A: The variance of the difference between groups are not equal since p(0.017)<0.05 in the Mauchly's test of sphericity. Therefore the assumptions is not satisfied!.we confirm that there is a variance of difference between groups.
353	1/9/2014	4:22 PM	M_G: done
354	1/9/2014	4:24 PM	H_A: i think we have to do in the same way a shw6
355	1/9/2014	4:24 PM	H_A: as hw6
356	1/9/2014	4:24 PM	H_A: am i right?
357	1/9/2014	4:27 PM	Z_B: I did not understood where you got p 0.017
358	1/9/2014	4:27 PM	H_A: it is from hw6
359	1/9/2014	4:27 PM	Z_B: ok
360	1/9/2014	4:27 PM	Z_B: but for this data, they are not smaller than p .05
361	1/9/2014	4:28 PM	Z_B: so we need to say there is not difference between groups
362	1/9/2014	4:28 PM	Z_B: ?
363	1/9/2014	4:28 PM	H_A: do we do mauchy's test
364	1/9/2014	4:28 PM	H_A: ?
365	1/9/2014	4:28 PM	Z_B: why should we do it?
366	1/9/2014	4:29 PM	H_A: actually I don't remember why but the above comment in hw6 may give explanation
367	1/9/2014	4:31 PM	Z_B: ok I will see again, but I think the first thing we need to do it just to do a simple anova for each dependent variable as we did, and then decide whether we should do a post hoc or contrast ... because we don't have difference between groups, maybe we can say that we don't need to do post hoc, etc because if there is not any difference, we don't need to compare groups, or we can do it to check our ANOVA results..
368	1/9/2014	4:31 PM	H_A: sphericity test: the variances of the differences between all possible pairs of groups
369	1/9/2014	4:32 PM	H_A: i agree with you
370	1/9/2014	4:32 PM	M_G: i agree, we need to one-way anova only

371	1/9/2014	4:32 PM	H_A: then how do we understand differences between groups?
372	1/9/2014	4:32 PM	M_G: one-way
373	1/9/2014	4:32 PM	H_A: sphericity test?
374	1/9/2014	4:34 PM	Z_B: one way Anova result says this, does not it? as groups I think we mean first-second and third years because we cannot compare dependent variables in anova
375	1/9/2014	4:34 PM	H_A: i did sphericity test
376	1/9/2014	4:34 PM	H_A: p>0.05
377	1/9/2014	4:34 PM	H_A: so there is no differences between groups where year is with in subject
378	1/9/2014	4:34 PM	H_A: s
379	1/9/2014	4:34 PM	Z_B: right
380	1/9/2014	4:35 PM	H_A: no, we may take dependent as independent and check them among themselves?
381	1/9/2014	4:35 PM	H_A: as i did repeated measure for one way anova just a second ago
382	1/9/2014	4:35 PM	H_A: to find the sphericity
383	1/9/2014	4:36 PM	Z_B: can we?
384	1/9/2014	4:36 PM	H_A: i think so
385	1/9/2014	4:36 PM	Z_B: I don’t know
386	1/9/2014	4:36 PM	H_A: then how we find the differences between groups?
387	1/9/2014	4:37 PM	Z_B: we use manova
388	1/9/2014	4:37 PM	Z_B: :)
389	1/9/2014	4:37 PM	M_G: i don't find sphericity
390	1/9/2014	4:37 PM	Z_B: because in anova we cannot have more than one dependent variable
391	1/9/2014	4:37 PM	Z_B: we can use them as independent variables I think while we are doing follow-up test for manova
392	1/9/2014	4:37 PM	H_A: there is factor
393	1/9/2014	4:37 PM	H_A: let me share teamviewre
394	1/9/2014	4:37 PM	H_A: team viewer
395	1/9/2014	4:38 PM	H_A: yes i did so
396	1/9/2014	4:38 PM	Z_B: ok but
397	1/9/2014	4:38 PM	Z_B: it is not manova
398	1/9/2014	4:38 PM	Z_B: we are just using anova
399	1/9/2014	4:38 PM	Z_B: for individual dependent variables
400	1/9/2014	4:38 PM	H_A: yes
401	1/9/2014	4:39 PM	Z_B: so we don’t need to compare dependent variables
402	1/9/2014	4:39 PM	H_A: then how we find differences?
403	1/9/2014	4:39 PM	H_A: between dependent variables
404	1/9/2014	4:39 PM	H_A: i stucked?
405	1/9/2014	4:40 PM	H_A: is there a table to conclude in differences of groups?

406	1/9/2014	4:39 PM	Z_B: the question does not want us to do that
407	1/9/2014	4:40 PM	H_A: o
408	1/9/2014	4:40 PM	H_A: k
409	1/9/2014	4:41 PM	H_A: then we will read 5 different anova result?
410	1/9/2014	4:41 PM	H_A: as you sent us
411	1/9/2014	4:41 PM	Z_B: I think so
412	1/9/2014	4:42 PM	M_G: i do not understand this part.
413	1/9/2014	4:42 PM	M_G: does it make sense to conduct contrasts or post-hoc tests?
414	1/9/2014	4:42 PM	Z_B: we can try to see if really there is not any difference between groups
415	1/9/2014	4:43 PM	H_A: the from 5 anova, we can say they are not significant therefore they are same?
416	1/9/2014	4:43 PM	H_A: am i right?
417	1/9/2014	4:43 PM	Z_B: yes, that's what I understood
418	1/9/2014	4:43 PM	H_A: ok
419	1/9/2014	4:44 PM	H_A: actually i don't know anything about contrast and post-hoc test
420	1/9/2014	4:44 PM	Z_B: yet think all the five outputs separately
421	1/9/2014	4:44 PM	H_A: i may not be able to participate in this part :(
422	1/9/2014	4:44 PM	Z_B: don't compare them with each other
423	1/9/2014	4:44 PM	H_A: sorry
424	1/9/2014	4:44 PM	H_A: agreed
425	1/9/2014	4:46 PM	Z_B: for clarification, even for myself, as far as I understood, for instance for statistics, anova says the groups are the same, so first year, second and third year students do not differ much from each other....
426	1/9/2014	4:45 PM	H_A: "Once you have determined that differences exist among the means, post hoc range tests and pairwise multiple comparisons can determine which means differ. "
427	1/9/2014	4:45 PM	H_A: no need to post-hoc?
428	1/9/2014	4:45 PM	H_A: am i right?
429	1/9/2014	4:46 PM	H_A: agreed
430	1/9/2014	4:46 PM	H_A: i understood so

Analysis of the messages between lines 325 and 430 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. H_A offered to apply anova for each dependent variable (327) and Z_B agreed. Z_B sent the anova results and interpreted that there is difference between groups across years (347), which demonstrated the *idea generation* phase. She then asked for the correctness of the solution. H_A checked the previous homework and shared the interpretation (352). Based on this explanation, Z_B interpreted that there is no difference between groups (361), which can be considered in *idea connection* phase.

H_A asked if they should apply mauchy's test (line 363). As a response, Z_B explained that they should apply anova, and post hoc according to anova results (367), which illustrated the *idea generation* phase. Other members agreed with the offer of Z_B (369, 370). Between lines 317 and 391 H_A indicated that he applied sphericity test in order to understand differences between groups and interpreted that there is no differences between groups where year is within subject. On the other hand, Z_B suggested that one way Anova result provides this result as well, which is considered in *idea connection* phase.

H_A experienced confusion in finding difference between dependent variables (402, 403). Z_B responded that the question doesn't require finding the difference between dependent variables (406), and H_A gained understanding.

M_G had problem in understanding the appropriateness of the contrasts or post-hoc tests (413). Z_B responded that they should check the difference to decide contrasts or post hoc tests (414). H_A also indicated that he didn't know about the contrasts and post hoc tests (419). Z_B provided appropriate explanations (425), which illustrated the *idea connection* phase.

RESULTS OF TEAM5

Segments and Matching Questions

Ass. 1												
Segment	S5	S6	S7	S8	S11	S12	S14	S15	S16	S21	S22	S23
Question	1c	1c	1b	1d	1b	2b		2e	1a	2a	2b	2a
Ass. 1												
Segment	S26	S28	S30	S31	S32	S33	S34	S35	S37	S39	S44	S45
Question	2b	2b		2b	2b		2c	2c	2c	2d	2e	2a
Ass. 1												
Segment	S46	S49	S51	S52	S54							
Question		2b	2a	2d								
Ass. 2												
Segment	S2	S3	S5	S9	S10							
Question	1	1	1	1	4f							
Ass. 3												
Segment	S2	S3	S8	S10	S11	S12	S13	S18	S19	S22	S27	
Question	a	c	c	c	d	d	f		f	g	d	
Ass. 4												
Segment	S2	S4	S5	S6	S7	S8	S9	S10	S13	S15	S16	S17
Question					1	2	2		1	1	2	2
Ass. 4												
Segment	S20	S21	S22	S23								
Question	5	3	4	5								
Ass. 5												
Segment	S2	S3	S5	S6	S7	S8	S9					
Question	a	b	b	c	c	d	e					
Ass. 6												
Segment	S2	S3	S4	S8	S11							
Question	c	d	e	c								
Ass. 7												
Segment	S2	S3	S4									
Question	a	b	c									

Learners' Conceptual Development in Chat Environment and Reflections of Chat Discussions to Wiki Output

VARIABLES CONCEPT

Assignment-1
Dependent and Independent Variables

At the beginning of the discussion, A_B categorized the condition and puzzle as independent variables(line 36). This offer was followed by agreement of D_C (line 38). Afterwards, A_B attempted to provide rationale for independent variables. That is, he interpreted that condition and puzzle variables are independent since they are not changed or affected by any other variable (line 39). This solution demonstrated that the team properly provided categorization and reasoning related to the independent variable type.

The next activity of the team focuses on finding dependent variables. For this purpose, A_B provided an explanation that task completion time and response variables are dependent

because of their reliance to independent variables (e.g. task and condition) (line 40).After this suggestion, A_B expected to understand if other members thought in the same way (line 41). As a response, D_C indicated her agreement to the opinions of A_B (line 42). To summarize, the team correctly decided on dependent variables, and provided appropriate reasoning.

Line	Date	Post Time	Chat Message / Whiteboard Activity
36	11/04/2013	2:20 PM	A_B: Condition and Puzzle variables are independent
37	11/04/2013	2:20 PM	A_B: because
38	11/04/2013	2:20 PM	D_C: yeah, I think these are good
39	11/04/2013	2:21 PM	A_B: they do not change or affected by any other variable
40	11/04/2013	2:21 PM	A_B: Task_completion_time and response variables are dependent because they depend on the task and condition :) clear.
41	11/04/2013	2:22 PM	A_B: do you agree?
42	11/04/2013	2:22 PM	D_C: yes, I agree with them. I also thought like that

Analysis of the messages between lines 36 and 42 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. A_B offered independent variables (line 36, 39) and dependent variables with the reasoning (line 40), which illustrated the *idea generation* phase. D_C agreed with ideas of A_B (38, 42).

Scales of Variables

In this session, the team attempts to define scales of variables. In his initial message (line 51), A_B provided a comprehensive explanation related to the measurement scales. He categorized the condition and puzzle in nominal scale by specifying them as categories and stating impossibility of ordering them. According to the case provided in the question, the grouping of nominal variables was correct. In addition, the rationale was properly presented since nominal variables are defined with their categories.

In the same message, A_B grouped the response and the completion time in interval scales. After the categorizations, he considered providing rationales for these variables. He stated for the response variable that the difference between 4-3 is the same as the difference between 10-9. Next, he explained the reason why the response and completion time is not in ratio scale. His interpretation revealed that the 0 value in these variables doesn't mean "no response" (line 51). However, he was not sure enough whether the response variable is in interval scale (line 52). D_C thought the completion time and response in interval scale since they don't consist of any classification (line 53) and the absolute 0 (line 54).Although members provided same categorization for the response and completion time, they provided different reasoning. Actually, A_B's reasoning was more appropriate since interval variables are structured with equal intervals but without absolute 0 value.

Line	Date	Post Time	Chat Message / Whiteboard Activity
51	11/04/2013	2:27 PM	A_B: according to the explanation: Condition and Puzzle are nominal because they are categories basically. We cannot order them. Response variable is interval because it's the number of steps to solve the problem. The difference between 4-3 is the same as the difference between 10-9. It's not ratio because the value 0 in response variable does not mean "no response" (this may vary so think again) Completion time is interval again. It's not ratio because 0 does not mean no response.
52	11/04/2013	2:28 PM	A_B: I have some doubts about response, i think it's interval but not very sure
53	11/04/2013	2:29 PM	D_C: yes, I also thought like that because we do not have any classification so we cannot say that completion time and response are discrete ones
54	11/04/2013	2:30 PM	D_C: and we do not have an absolute 0.

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 51 and 54 can be analyzed as follows. In the initial message, A_B shared the solution and reasoning related to the scales of variables, which is considered in *idea generation* phase. Then, he indicated that he wasn't sure whether the response is in interval scale (line 52). In order to satisfy understanding of A_B, D_C explained the lack of classification and absolute 0 in response variable and categorized it in interval scale (line 53, 54), which demonstrated the *idea connection* phase.

Wiki Reflection

In the chat environment, the team had already identified the independent and dependent variables, and provided appropriate reasoning. The same decision was reflected to the wiki output as follows: "In this study, condition and puzzles are independent variables while task completion time and response are dependent variables. The reason why condition and puzzles are independent is that they do not change according to the other variables. They are not affected by other variables. Task completion time and response are dependent variables because they change according to the type of condition and puzzle."

During the chat discussion, the team had accurate opinions for the scales of condition, puzzle, and task completion time. They experienced confusion while identifying the scale of response variable but finally decided that it is in interval scale. As a result, the team reflected all their decisions in the chat to the wiki content –"Condition and puzzles are nominal. We cannot order them because they are basically categories. On the other hand, response variable which is the number of steps to solve the problem is interval. For this variable, the differences between values are the same. For example, the difference between 3 and 4 is the same as the difference between 9 and 10. For the same reason, completion time is also interval. Both response and completion time do not have an absolute 0. The value 0 does not mean that there is no response."

Assignment-2

Dependent and Independent Variables

In the initial chat message, D_C stated her confusion in identifying dependent variables. She actually experienced confusion while deciding whether intelligence or physiological properties are dependent ones (line 35). After reviewing a similar question, H_K categorized the IQ variables as dependent (line 36-39). D_C stated her agreement to the offer of H_K (line 40).Although one of the members experienced difficulty in detecting the dependent variable, the team's final decision demonstrated that they could correctly identify it with the help of knowledge sharing in the group.

As the next activity, the team started to find independent variables. D_C thought that the gender variable can be covariance (line 48). However, H_K indicated his disagreement to the offer of D_C (line 49). As a result, D_C changed her decision and offered the gender as independent variable (line 52). H_K provided confirmation to that suggestion (line 53), and then stated that height and weight are also independent (line 54). D_C indicated her agreement to offers of H_K (line 42).Although one of the members had confusion between covariance and independent concepts at the beginning, the team's final decision demonstrated that they could correctly identify it by exchanging knowledge in the group.

Line	Date	Post Time	Chat Message / Whiteboard Activity
35	11/16/2013	12:37 PM	D_C: actually I am not sure about the dependent variables. is intelligence dependent? or the physiological ones?
36	11/16/2013	12:36 PM	H_K: i am then looking at question 4
37	11/16/2013	12:39 PM	H_K: yes
38	11/16/2013	12:39 PM	H_K: all IQ variables are
39	11/16/2013	12:40 PM	H_K: dependent
40	11/16/2013	12:40 PM	D_C: all right
48	11/16/2013	12:43 PM	D_C: By the way, is gender covariance?
49	11/16/2013	12:44 PM	H_K: I think no
50	11/16/2013	12:44 PM	D_C: so, it is also IV.
51	11/16/2013	12:45 PM	H_K: what do you mean by IV
52	11/16/2013	12:46 PM	D_C: independent variable
53	11/16/2013	12:46 PM	H_K: sure
54	11/16/2013	12:47 PM	H_K: gender height weight are also independent variable
55	11/16/2013	12:47 PM	D_C: all right

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 35 and 55 can be analyzed as follows. Initial message of D_C reflects his confusion about the dependent variable, which can be considered trigger activity. H_K offered iq variables as dependent (line 38, 39), which illustrated the *idea generation* phase. D_C agreed with this idea (line 40), and asked if gender covariance (line 48). H_K disagreed with the offer of D_C (line 49). Then, D_C offered the gender as independent (line 52), and H_K proposed the height and weight as independent (line 54), which are considered in *idea generation* phase.

Scales of Variables

In line 80, the team shared the solution that lists dependent and independent variables that they previously identified. In addition, they categorized variables in terms of their scales. They proposed that physiological parameters and IQ variables are in interval scale since the equality of difference between 9-10 and 11-12,and extinction of absolute 0. Yet, in an upcoming meeting, A_B indicated his dissatisfaction about the solution they provided (line 171). Hence, H_K offered that they could perform the question again (line 174). A_B was confused about the scale of the iq variable. He thought that ordinal scale may be suitable for that variable (line 175-177). On the other hand, H_K offered the appropriateness of the interval scale by stating extinction of absolute 0 for iq variable (179-182). Then, A_B shared the explanation for the ordinal scale that "these data tell us nothing about the differences between values" (line 183). After understanding this explanation, A_B proposed that iq should be in interval scale (line 184, 185). The team had initially categorized the iq variable correctly and provided appropriate reasoning. However, one member was confused about its scale and though that it can be in ordinal level. With the guidance of another team member and his own share of definition for ordinal variable, he could understand that iq variable should be in interval scale.

Line	Date	Post Time	Chat Message / Whiteboard Activity
80	11/16/2013	1:22 PM	*The team shared the solution "In this research design, while brain volume, gender, height and weight are independent variables, all IQ variables are dependent variables. Intelligence changes according to the physiological factors. While physiological parameters and IQ variables are interval, gender variable is nominal. The difference between 9-10 and 11-12 is the same and we do not have an absolute 0. Therefore, physiological parameters and IQ variables are interval and since we only have male and female as gender, gender variable is nominal." in the whiteboard*
171	11/18/2013	5:56 PM	A_B: I'm not very satisfied with the question 1 explanation
173	11/18/2013	5:57 PM	H_K: ok
174	11/18/2013	5:57 PM	H_K: lets do it again
175	11/18/2013	5:58 PM	A_B: I'm not sure that IQ is interval
176	11/18/2013	5:58 PM	A_B: what do you think?
177	11/18/2013	5:59 PM	A_B: it feels like ordinal to me but then again it's like interval :)
178	11/18/2013	5:59 PM	H_K: hımm.
179	11/18/2013	5:59 PM	H_K: There is not true zero for IQ
180	11/18/2013	5:59 PM	H_K: it feels ordinal
181	11/18/2013	6:01 PM	H_K: No
182	11/18/2013	6:02 PM	H_K: this is interval
183	11/18/2013	6:02 PM	A_B: " However, these data tell us nothing about the differences between values"
184	11/18/2013	6:02 PM	A_B: yes
185	11/18/2013	6:02 PM	A_B: this explanation is for ordinal so its interval

Analysis of the messages between lines 171 and 185 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. A_B was confused

about the scale of the iq variable and thought that it can be ordinal (line 175-177), which can be considered in *idea generation* phase. H_K explained that iq variable is in interval scale because of the extinction of absolute 0 for iq variable (179-182), which demonstrated the *idea connection* phase. A_B shared the explanation for the ordinal scale that "these data tell us nothing about the differences between values" (line 183) and understood thatiq should be in interval scale (line 184, 185), which illustrated the *idea improvement* phase.

In the previous discussion, the team categorized physiological parameters in interval scale. However, H_K revised their solution by stating height and weight in ratio, which was more appropriate categorization (line 187). A_B experienced confusion about the scale of the height variable. He considered the situation in the real life and asked if there is a person without height. In addition, he indicated that the dataset doesn't consist of "no height" situation. Therefore, he suggested the height to be in interval scale (line 189-191). In order to explain the idea, H_K considered the weight and categorized it in ratio scale since 0 kg means nothing (line 193-194). A_B indicated her understanding (line 195). Then, A_B focused on scale of the MRI volume. He proposed that it should be in ratio scale since weight is ratio (line 197, 198). However, he had confusion about the reasoning for the scale of the MRI volume. Therefore, he asked if 0 value means no brain regarding the MRI volume variable (line 199). H_K indicated her confirmation to the question of A_B by stating equality of 0 kg brain to no brain (line 203).

Line	Date	Post Time	Chat Message / Whiteboard Activity
186	11/18/2013	6:02 PM	H_K: gender is nominal
187	11/18/2013	6:03 PM	H_K: height and weight are ratio
188	11/18/2013	6:03 PM	A_B: yes
189	11/18/2013	6:04 PM	A_B: well according to the description yes but in real life is this ok? no height in a person?
190	11/18/2013	6:04 PM	A_B: and there is no "no height" situation in the dataset
191	11/18/2013	6:05 PM	A_B: i think it's interval?
192	11/18/2013	6:05 PM	H_K: 0 kg means
193	11/18/2013	6:05 PM	H_K: nothing
194	11/18/2013	6:06 PM	H_K: so it is ratio
195	11/18/2013	6:07 PM	A_B:hımm, ok
196	11/18/2013	6:07 PM	H_K: I have sent you an email
197	11/18/2013	6:09 PM	A_B: ok weight and height are ratio so what about MRI_Volume?
198	11/18/2013	6:10 PM	A_B: if weight is ratio then this should be ratio
199	11/18/2013	6:10 PM	A_B: but does 0 mean no brain?
200	11/18/2013	6:10 PM	H_K: right
201	11/18/2013	6:10 PM	A_B: :)
202	11/18/2013	6:10 PM	A_B: well i'm confused so i trust you in this
203	11/18/2013	6:11 PM	H_K: physiologicaly yes 0 kg brain = no brain :)

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 186 and 203 can be analyzed as follows. H_K offered the gender as nominal (186), weight

and height as ratio (187), which represented the *idea generation* phase. A_B considered the real life and offered the height in interval scale (189-191), which can be considered in *idea connection* phase. H_K explained that weight is in ratio scale since 0 kg means nothing (192-194), which demonstrated the *idea connection* phase. A_B agreed (195) and asked if MRI_Volume is also ratio based on scale of weight (197-199), which can be considered in *idea connection* phase. H_K provided confirmation to the idea of A_B (200).

Wiki Reflection

For the types of dependent and independent variables, the team reflected all of their decisions in the chat environment to the wiki deliverable: "In this research design, while brain volume, gender, height and weight are independent variables, all IQ variables are dependent variables. Intelligence changes according to the physiological factors."

Regarding scales of variables, the team shared the following output: "While physiological parameters and IQ variables are interval, gender variable is nominal. The difference between 9-10 and 11-12 is the same and we do not have an absolute 0. Therefore, physiological parameters (height,weight,volume) are ratio and IQ variables are interval and gender variable is nominal."This content demonstrated that the team correctly identified scales of iq variable. In addition, they provided correct reasoning for the interval scale by stating equal intervals and extinction of absolute 0. However, the scale of gender should be binary since it consists of two categories. For the scale of the physiological parameters, they both offered interval and ratio scales. Their second categorization was correct, but they should mention existence of ratios along the scales, and occurrence of a true and meaningful zero for the reasoning of ratio scale.

Assignment-4
Dependent and Independent Variables
A_B proposed pretest and posttest as dependent, group and students as independent variables (line 228). However, D_C had different opinion. She thought that reading comprehension is dependent and different instructions are independent variables (line 229). According to her idea, pretest and posttests are provided for showing the difference between the instructions (line 230). A_B stated that his idea was based on the existence of 3 columns (i.e. group, pretest and posttest) in the data structure (line 231). On the other hand, D_C offered that these columns are available to measure the effects of instructions (line 232). She also provided further explanation. She proposed that reading comprehension changes in terms of the instruction and the tests have no effect (line 244). A_B approved the idea of D_C (line 245). D_C offered the roles of tests that they allow the researchers to analyze and discover what is going on with these different instructions (line 246). A_B couldn't exactly capture the idea of D_C. He understood that D_C had suggested group and posttest as dependent, and pretest as independent (line 248). Therefore, D_C explicitly explained her idea again. She stated that tests are not considered and different instruction groups are dependent (line 249).

Line	Date	Post Time	Chat Message / Whiteboard Activity
228	12/11/2013	2:13 PM	A_B: so dependent variables are pretest and posttest, independent variables are group and students in this case
229	12/11/2013	2:14 PM	D_C: actually I think, reading comprehension is the dependent variable and different instructions are independent variables.
230	12/11/2013	2:15 PM	D_C: pretest and posttests are just used for seeing the difference between the instructions I think
231	12/11/2013	2:16 PM	A_B: yes this point of view is not wrong but if you see the data structure there are 3 columns: group, pretest and posttest
232	12/11/2013	2:17 PM	D_C: yeah but I think just to measure the effects of instructions, they are there.
244	12/11/2013	2:17 PM	D_C: I mean in this research, comprehension changes according to the instruction. there is no effect of pretest and posttest.
245	12/11/2013	2:19 PM	A_B: yes absolutely true
246	12/11/2013	2:21 PM	D_C: they help us to analyze and figure out what is going on with these different instructions
247	12/11/2013	2:21 PM	D_C: :/
248	12/11/2013	2:21 PM	A_B: well so you're saying group and posttest are dependent where pretest is independent? did i get it right?
249	12/11/2013	2:21 PM	D_C: no, I dont say anything about pretest and post test. I am just saying that different instruction groups are dependent

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 228 and 249 can be analyzed as follows. In the first message, A_B proposed the test scores as dependent, group and students as independent variables (228), which demonstrated the *idea generation* phase. On the other hand, D_C suggested reading comprehension as dependent and instructions as independent variables (229), which is considered in *idea generation* phase. A_B indicated the columns (group, pretest and posttest) in the data structure to support his idea (line 231). However, D_C suggested that availability of these columns is to measure the effects of instructions (line 232). She additionally provided further explanation, she offered that reading comprehension changes in terms of the instruction and the tests have no effect (line 244), which demonstrated the *idea connection* phase. A_B agreed with the idea of D_C (line 245). A_B asked the dependent and independent variables (248). D_C responded that different instruction groups are dependent, which can be considered in *idea generation* phase (249).

Then, A_B asked the opinion of D_C about the effects 3 variables in the dataset. A_B explained that there is no effect in the pretest, but the instruction type effects the results in the post test (line 250-252). D_C provided the reasoning that the difference between pretest and post test results demonstrate the effect of the instruction. Moreover, she stated that the result demonstrates the increase in reading comprehension, hence makes it dependent variable (line 253). However, according to A_B, reading comprehension is not affected by anything, hence identified it as the cause (line 254, 255). Then, A_B changed his first assumption and offered pretest and group as independent, posttest as dependent (line 256). Yet, D_C didn't think pretest and posttest are directly variables (line 257). Therefore, A_B

provided the dataset as evidence that indicates pretest and posttest as direct variables (line 263). After that, D_C indicated her agreement to offers of A_B (line 264).

Line	Date	Post Time	Chat Message / Whiteboard Activity
250	12/11/2013	2:27 PM	A_B: ok so what's your opinion about the effects of your statement to the 3 variables?
251	12/11/2013	2:28 PM	A_B: because we need to infer over the results, the variables.
252	12/11/2013	2:29 PM	A_B: in pretest there is no effect, but in posttest instruction type effects the posttest result...?
253	12/11/2013	2:30 PM	D_C: I think, the significant difference between pretest and posttest shows whether the instruction is good or bad. therefore, the significant increase in reading comprehension is the result. This takes us to reading comprehension as the dependent variable.
254	12/11/2013	2:32 PM	A_B: ok, but here a point. reading comprehension is not effected by anything else, but it effects the result which is the result of reading comprehension.
255	12/11/2013	2:33 PM	A_B: reading comprehension is an assistance, it is not the result, it is the cause
256	12/11/2013	2:34 PM	A_B: so i change my first assumption according to your guidance; pretest and group are independent, posttest is dependent. what do you think?
257	12/11/2013	2:35 PM	D_C: yeah something like that. But I could not be persuaded pretest and posttests are directly variables.
263	12/11/2013	2:36 PM	A_B: there is an evidence that they are directly variables: reading.sav
264	12/11/2013	2:36 PM	D_C: all right :)

Analysis of the messages between lines 250 and 264 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. First message of A_B can be considered trigger activity that aims to gather opinions about the effects of variables. Then, he suggested that there is no effect in pretest, instruction type effects the posttest result (252), which demonstrated *the idea generation* phase. D_C provided a related explanation that "the significant difference between pretest and posttest shows whether the instruction is good or bad. therefore, the significant increase in reading comprehension is the result. This takes us to reading comprehension as the dependent variable" (line 253), which can be considered in *idea connection* phase. Between lines 254 and 256, A_B agreed with the idea of D_C, and stated that reading comprehension is the cause, pretest and group as independent, posttest as dependent variables, which illustrated the *idea connection* phase. However, D_C didn't think pretest and posttest are directly variables (line 257). Hence, A_B provided the dataset as evidence that indicated pretest and posttest as direct variables (line 263), which demonstrated *the idea connection* phase. After that, D_C indicated her agreement to offers of A_B (line 264).

Wiki Reflection

In the chat environment, initially the team couldn't come to a decision while identifying dependent and independent variables. A_B firstly proposed that dependent variables are pretest and posttest, independent variables are group and students. On the other hand, D_C thought that reading comprehension is the dependent variable and different instructions are independent variables. After the explanations, A_B changed his initial decision and stated that pretest and group are independent, posttest is dependent according to his understanding. Although D_C didn't initially consider the tests as variables, then he was persuaded with the statements of A_B.

On the other hand, the wiki output had different content in terms of the team's last decision in the chat. They proposed the reading comprehension, pre and post tests as dependent, and methods of instruction as independent. This output demonstrated that the team reached the correct categorizations while working on the wiki environment.

Assignment-5

D_C offered the mood as independent variable and asked for the confirmation (line 19). As a response, A_B agreed but also considered stop rule as the other independent variable (line 20). On the other hand, D_C didn't approve that the stop rule is in independent type (line 21). Then, he offered the taking belongings as dependent variable (line 22). A_B indicated his agreement to the suggestion of D_C (line 23).

Line	Date	Post Time	Chat Message / Whiteboard Activity
19	12/21/2013	3:15 PM	D_C: mood is independent, right?
20	12/21/2013	3:15 PM	A_B: yes mood and stop_rule are independent variables
21	12/21/2013	3:16 PM	D_C: no, this structure is okay
22	12/21/2013	3:16 PM	D_C: and the taking belongings is dependent
23	12/21/2013	3:17 PM	A_B: yes listcount is independent

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 19 and 23 can be analyzed as follows. In these lines, members offered the independent and dependent variables, which showed the *idea generation* phase.

Wiki Reflection

The team reflected their decisions about dependent and independent variables to the wiki deliverable. That is, they wrote that "There are two independent (mood and stop_rule) and one dependent variable (list count) in this study." In addition, they provided additional definition for the independent variables by stating that they represent the interventions that researcher wants to measure. The chat and wiki contents revealed that, the group correctly identified dependent and independent variables. However, it could be better if they provided reasoning for these variables.

Assignment-6

In this assignment, the team attempted to detect dependent and independent variables while trying to identify the research design of the study. This was a meaningful approach since the research design is related to the number of independent variables in the case provided by the assignment. The discussion started with the question of A_B for the purpose of understanding existence of independent variables in the study(line 128). H_K explained his first idea that groups were independent (line 130). But then, he considered a related resource and identified the repeated measure factor as the independent variable (line 130-134). A_B found the idea of H_K meaningless since he thought that this kind of categorization makes columns as independent. On the other hand, values should be dependent in terms of his idea (line 135). In addition, he wasn't sure if the one way design is appropriate for the case (line 136). H_K explained his idea that it is one way repeated design since there is one factor (line 137-139). Hence, A_B offered to check the research design again (line 141). Before applying to a related resource, he asked the appearance of data when the research design is in two-way (line 142). H_K responded that there were two independent variables if the design was two way (line 143, 144). A_B faced with difficulty of understanding two-way research design, hence asked how they can organize data structure in two-way research design (line 145). H_K decided to explain the structure by providing a related example. He considered gender and condition as two different factors and presented the design structure as follows: A-Condition1, A-Condition2, A-Condition3, B-Condition1, B-Condition2, B-Condition3 (line 146-148). A_B expected to understand if the research design in their case consists of one treatment on 3 conditions (line 150). H_K indicated agreement to the suggestion of A_B (line 151). Then, A_B reached the correct solution that the dependent variable is measure of pursuing rotating circle and the independent variable is the frequency of the click sound (line 152). However, A_B stated that he already had confusion about the research design hence indicated his need to understand the difference between two way and one way repeated measures later on (line 153). H_K approved this idea (line 154).

Line	Date	Post Time	Chat Message / Whiteboard Activity
128	01/02/2014	4:12 PM	A_B: are there no independent variables?
129	01/02/2014	4:13 PM	H_K: That part is some how controversial
130	01/02/2014	4:14 PM	H_K: I thought groups were independent
131	01/02/2014	4:14 PM	H_K: But I saw in somewhere that the factor
132	01/02/2014	4:14 PM	H_K: is independent
133	01/02/2014	4:15 PM	H_K: Repeated measure factor
134	01/02/2014	4:15 PM	H_K: So, I typed that on wiki
135	01/02/2014	4:16 PM	A_B: this is weird, it is like columns are (in our dataset) independent but values are dependent
136	01/02/2014	4:18 PM	A_B: and one way part is controversial
137	01/02/2014	4:18 PM	H_K: yeah
138	01/02/2014	4:19 PM	H_K: I thought there is one factor
139	01/02/2014	4:19 PM	H_K: so this is one way repeated
140	01/02/2014	4:20 PM	H_K: as in the example of bushtucker
141	01/02/2014	4:20 PM	A_B: ok let me check it again
142	01/02/2014	4:27 PM	A_B: how would our data look like if this were two way?
143	01/02/2014	4:28 PM	H_K: there were two independent variables

144	01/02/2014	4:28 PM	H_K: if it was two way
145	01/02/2014	4:29 PM	A_B: ok but how would we organize data structure? do you have any idea?
146	01/02/2014	4:31 PM	H_K: there would be two factors
147	01/02/2014	4:31 PM	H_K: like group A for male Group B for female some conditions
148	01/02/2014	4:32 PM	H_K: A-Condition1 , A-Condition2, A-Condition3, B-Condition1, B-Condition2, B-Condition3
149	01/02/2014	4:34 PM	A_B: hımm ok, it's little bit complicated
150	01/02/2014	4:34 PM	A_B: so in this case we can say we have one treatment on 3 conditions
151	01/02/2014	4:35 PM	H_K: yeah
152	01/02/2014	4:38 PM	A_B: ok our dependent variable is measure of pursuing rotating circle and our independent variable is the frequency of the click sound
153	01/02/2014	4:40 PM	A_B: it is ok but i need (later) to understand what is the difference between two way and one way repeated measures, why can't we assume these three conditions as independent variables...
154	01/02/2014	4:40 PM	H_K: ok

Based on the Progressive Knowledge Building Inquiry cycle, messages between lines 128 and 154 can be analyzed as follows. Initially, A_B asked if there are no independent variables. Between lines 129 and 133, H_K offered that repeated measure factor is independent, which illustrated the *idea generation*. However, A_B thought that columns are independent and values are dependent (135), which can be considered in *idea generation* phase. Moreover, A_B wasn't sure if the one way design is appropriate for the case (line 136). H_K explained his idea that it is one way repeated design since there is one factor and considered a related example (line 137-140), which illustrated the *idea connection* phase. A_B asked the organization of data in two way design (line 142). Between lines 143 and 148, H_K provided detailed explanation and example, which demonstrated *idea improvement* phase. A_B asked if the research design in their case consists of one treatment on 3 conditions (line 150), which is considered in *idea generation*. H_K agreed with the suggestion of A_B (line 151). Then, A_B found the correct solution that the dependent variable is measure of pursuing rotating circle and the independent variable is the frequency of the click sound (line 152), which reflected the *idea connection*. However, A_B stated that he already had confusion about the research design hence indicated his need to understand the difference between two way and one way repeated measures later on (line 153). This thought can be considered in rise above phase, since the member knows about his lack of understanding and attempts to gain knowledge.

Wiki Reflection

The team's final decision about the dependent and independent variables in the chat environment was reflected to wiki delivery. In the wiki, they stated that dependent variable is the measurement of pursuing rotating circle and the independent variable is the frequency of the click sound. This solution demonstrated that the team could correctly detect dependent

and independent variables. In addition, they provided explanation in the wiki output - "The repeated-measure factor which is within subject factor is independent variable, while the conditions on which each participant is measured is the dependent variable."

Assignment-7

D_C thought that the solution of the first question was obvious (line 28), and offered the year as independent and other variables as dependent (line 29). Then, H_K indicated his agreement to offers of D_C (line 264). According to the statement in the question, the other variables refer the test scores in various fields of psychology. Therefore the name of variables could be explicitly stated in the solution.

Line	Date	Post Time	Chat Message / Whiteboard Activity
28	01/09/2014	3:22 PM	D_C: so I think the first question is obvious right?
29	01/09/2014	3:22 PM	D_C: year is independent variable, the rest is dependent variable?
30	01/09/2014	3:22 PM	H_K: Yeah
31	01/09/2014	3:23 PM	H_K: right

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 28 and 31 can be analyzed as follows. In lines 29, D_C offered the independent and dependent variables, which showed the *idea generation* phase. H_K agreed with the idea.

Wiki Reflection

In the chat environment, the team decided on dependent and independent variables. They implied that dependent variables are test scores in major types, and independent variables are academic year of students. They wrote these decisions to the wiki text. Although they didn't discuss about scales of the variables in the chat environment, they provided categorizations in the wiki. That is, they categorized test scores in interval and academic year of students in nominal scales.

Experience of the Team throughout Assignments

The team's progress of detecting dependent and independent variables occurred in a fluctuating way. In the initial assignment, the team identified the variables correctly and provided appropriate reasoning. In the second assignment, one member had difficulty in finding dependent and independent variables. With the guidance of another member, the team could reach the solution and detect the variables properly. While working on the fourth assignment, the team initially didn't share a common opinion about dependent and independent variables. They discussed about the issue and then came to a solution. In the remaining assignments, the team could properly detect the variables. In the fifth assignment, the team had no problem in recognizing variables and defining their types. Therefore, they could reach the solution without any confusion or discussion. In the sixth assignment, the team identified dependent and independent variables while working to define the research

design of the study. This was meaningful since the research design is related to the number of independent variables. In the last assignment, the member having difficulty in earlier examples could easily categorize the variables. This showed the team's progress in finding dependent and independent variables.

In the chat environment, the topic of scales of variables was discussed in the first and second assignments. The team could properly find the scales of variables and provided the appropriate reasoning for each scale.

Individual Progress of Team Members

A_B: In the first assignment, A_B correctly identified independent and dependent variables, and provided appropriate interpretation. In addition, he successfully categorized nominal and interval variables with the correct clarifications.

In the second assignment, A_B stated his confusion in classifying the iq as interval variable since he thought that it can be in ordinal level. With the guidance of H_K and his own share of definition for ordinal variable, he could understand that the iq variable should be in interval scale. Additionally, he experienced problem in understanding the scale of the height variable. He thought that the height should be in interval scale since there is no "no height" situation in the dataset. In order to explain the idea, H_K considered the weight and categorized it in ratio scale since 0 kg means nothing and A_B indicated her understanding. Then, A_B concluded that the MRI volume should be in ratio scale since weight is ratio. However, he had confusion about the reasoning for the scale of the MRI volume. Therefore, H_K provided the appropriate reasoning. This demonstrated that A_B understood the ratio variable but had problem about the interpretation.

In the fourth assignment, A_B initially offered that dependent variables are pretest and posttest, independent variables are group and students. However, D_C thought that reading comprehension is the dependent variable and different instructions are independent. After the explanations, A_B changed his initial decision and stated that pretest and group are independent, posttest is dependent according to his understanding. Although D_C didn't initially consider the tests as variables, then he was persuaded with the statements of A_B.

In the fifth assignment, A_B correctly identified independent and dependent variables. But, the interpretations were missing in the answer of the team.

In the sixth assignment, A_B experienced problem in detecting dependent and independent variables. However, after the collaboration, he reached the correct solution that the dependent variable is measure of pursuing rotating circle and the independent variable is the frequency of the click sound.

D_C: In the first assignment, D_C indicated her agreement to the offer related to dependent and independent variables, and scales of variables. Additionally, he provided reasoning for the interval scale by stating that the completion time and response in interval scale since they don't consist of any classification and the absolute 0. This reasoning was partly true since she could additionally mention the equality of intervals along the scales.

In the second assignment, D_C experienced problem in identifying dependent and independent variables. She couldn't decide whether intelligence or physiological properties are dependent variables. By reviewing a similar question, H_K categorized IQ variables as dependent and D_C stated her agreement to this offer. D_C thought that the gender variable is in covariance category. Yet, H_K indicated his disagreement to the offer of D_C. Therefore, D_C changed her decision and offered the gender as another independent variable.

In the fourth assignment, D_C proposed that reading comprehension is the dependent and different instructions are independent variables. After the exchange of ideas, A_B stated that pretest and group are independent, posttest is dependent according to his understanding. Although D_C didn't initially consider the tests as variables, then he was persuaded with the statements of A_B.

In the fifth assignment, D_C offered the mood as independent variable and asked for the confirmation of other group members. A_B proposed to consider stop rule as the other independent variable. However, D_C didn't approve that the stop rule is in independent type. This demonstrated the problem of D_C in categorizing all independent variables of the experiment. D_C offered that the taking belongings as dependent variable and A_B indicated his agreement to the suggestion of D_C.

In the seventh assignment, D_C correctly identified the year as independent and test scores as dependent variables. This demonstrated her progress in categorizing variables.

H_K: In two assignments, H_K adopted a guide role. In the second assignment, D_C experienced problem in detecting dependent and independent variables. H_K did the appropriate clarifications and guided D_C for her understanding. Then, A_B was confused about the type of IQ variable. He thought that its scale can be ordinal instead of interval. H_K provided the appropriate explanations and facilitated understanding of A_B. In addition, he identified nominal and ratio variables and provided correct interpretations.

In the sixth assignment, A_B experienced problem in detecting dependent and independent variables. Yet, after the guidance of H_K, the team reached the correct solution that the dependent variable is measure of pursuing rotating circle and the independent variable is the frequency of the click sound.

In the seventh assignment, D_C correctly identified the year as independent and test scores as dependent variables, and H_K provided agreement to this offer.

NORMALITY TEST

Assignment-1

The discussion about the normality test started with the question of A_B. He expected to understand whether they would consider results of k-s in this assignment (line 424). D_C agreed that they would interpret results belong to this test (line 427). The team decided on the k-s test instead of the s-w in terms of the sample size in the experiment. Since the experiment consists of 94 subjects, which is less than 30, use of k-s results is more appropriate.

D_C implied that she conducted the analysis and produced the normality results (line 425). As a suggestion, H_K asked D_C if she could share the results (line 430,431). While investigating the results, A_B offered to test the sigma value (line 426). On the other hand, he had lack of knowledge about the sigma value and asked its role in the normality test (line 434). H_K attempted provide an appropriate example to facilitate understanding of A_B. He explained that since the sigma value for toh picture condition is significant this condition is not normal (line 436). D_C had the same idea and clarified that it is not normal because sigma value is smaller than the p value, which is 0.05 (line 441).

A_B asked the grouping variable they need to take into account. That is, he expected to understand whether data should be grouped according to the puzzle or condition variable (line 440). H_K responded that the grouping was done according to the condition (line 442). However, A_B offered to group data by considering both puzzle and condition (line 443), which would lead to change in normality results previously produced by the group (line 446). H_K provided confirmation to consider two variables while grouping data and stated that they had forgotten this issue (line 445).

D_C had another question; she expected to understand if they would split the data (line 447). A_B proposed splitting data and provided reasoning that they considered all the picture data (toh and rp) (line 450).

Line	Date	Post Time	Chat Message / Whiteboard Activity
424	11/5/2013	7:54 AM	A_B: We'll do Kolmogorov Smirnov test for 2c right?
425	11/5/2013	7:54 AM	D_C: I think I have that results
426	11/5/2013	7:54 AM	A_B: and test the sigma value
427	11/5/2013	7:54 AM	D_C: yes Kolmogorov Smirnov one
430	11/5/2013	7:54 AM	H_K: could you paste it
431	11/5/2013	7:54 AM	H_K: o
432	11/5/2013	7:55 AM	D_C: is it true? q2-normality tab
434	11/5/2013	7:55 AM	A_B: ok what does it say, the sigma value?
435	11/5/2013	7:55 AM	H_K: Yeah we are right
436	11/5/2013	7:55 AM	H_K: TOH-Picture is significant , that means it is not normally distributed
437	11/5/2013	7:55 AM	D_C: yes because it is bigger than p value
438	11/5/2013	7:56 AM	H_K: But , TOH-Blank is normally distributed
439	11/5/2013	7:55 AM	D_C: 0.05
440	11/5/2013	7:56 AM	A_B: is this grouped by puzzle and condition or just condition?
441	11/5/2013	7:56 AM	D_C: ops, smaller than p value
442	11/5/2013	7:57 AM	H_K: Condition I think,
443	11/5/2013	7:57 AM	A_B: we need to group by both
444	11/5/2013	7:57 AM	D_C: yeah condition I think I also have it for response..
445	11/5/2013	7:57 AM	H_K: yes we forget that part
446	11/5/2013	7:57 AM	A_B: that will change the values
447	11/5/2013	7:58 AM	D_C: so are we going to split data?
448	11/5/2013	7:58 AM	A_B: yes like H_K did
449	11/5/2013	7:58 AM	D_C: all right then.
450	11/5/2013	7:58 AM	A_B: because here we took all picture data(toh and rp)

Analysis of the messages between lines 424 and 450 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. A_B offered to apply Kolmogorov Smirnov (424) and test the sigma value (426), which illustrated the *idea generation* phase. D_C indicated that he found the results of the Kolmogorov Smirnov (427) and shared the results. A_B asked the interpretation of sigma value (434). H_K responded that, TOH-picture is significant, hence not normally distributed (436), and TOH-Blank is normally distributed (434),which are considered in *idea generation* phase. D_C agreed with the significant result and stated its size as smaller than p value (441), which illustrated the *idea connection* phase. A_B asked the value considered for grouping (440) and H_K offered the condition as grouping value (442). A_B proposed to employ puzzle and condition while grouping (443), which is considered in *idea generation* phase. Other members agreed with the offer (444, 445).

D_C shared the normality results in the whiteboard area and asked other members' opinions about the results (line 453). D_C stated she split data according to the condition (line 455) and explained that she had all results in one chart (line 458). However, H_K had segmented results. He shared normality results for the rp picture condition (line 454) and for toh picture condition (line 459). Since the group previously decided on grouping data in terms of both puzzle and condition, the results provided by H_K was more appropriate compared to ones provided by D_C.

A_B asked whether the sigma value less than .5 indicates the significance and non-normality (line 461). While D_C agreed with this suggestion (line 462), H_K disagreed (line 463). But, H_K had actually similar idea since he stated that the p value less than 0.5 means significant and non-normal (line 464).A_B asked the p value they should consider (line 465). D_C stated the p as 0.05 (line 469) and H_K agreed (line 470). A_B also stated he checked and found it as .05 (line 471). Although the team firstly stated the p value as 0.5, then they noticed the correct value and corrected it as 0.05.

Line	Date	Post Time	Chat Message / Whiteboard Activity
453	11/5/2013	8:00 AM	D_C: how about this one?
454	11/5/2013	8:01 AM	H_K: Puzzle = RP, Condition= Picture , Normality Test Results
455	11/5/2013	8:01 AM	D_C:I split data according to the condition
456	11/5/2013	8:02 AM	D_C: the output is getting smaller, so funny :)
457	11/5/2013	8:02 AM	D_C: hmm, you do it one by one?
458	11/5/2013	8:03 AM	D_C: yes. and above this, I think now, I have all results in one chart..
459	11/5/2013	8:04 AM	H_K: Yeah, I pasted TOH-Picture
460	11/5/2013	8:04 AM	H_K: Let us see
461	11/5/2013	8:06 AM	A_B: this seems ok. so if sigma is smaller than .5 it's significant and not-normally distributed, right_
462	11/5/2013	8:06 AM	D_C: yes
463	11/5/2013	8:06 AM	H_K: no
464	11/5/2013	8:07 AM	H_K: if p-value is less than 0.5 , it means significant and not normally distributed

465	11/5/2013	8:07 AM	A_B: which p value?
466	11/5/2013	8:07 AM	D_C: p value is significant one
467	11/5/2013	8:07 AM	H_K: yes
468	11/5/2013	8:07 AM	A_B: ok the last answer is yes i suppose :)
469	11/5/2013	8:08 AM	D_C: by the way, the value is 0.05 I think
470	11/5/2013	8:08 AM	H_K: yes you are right I made a mistake
471	11/5/2013	8:08 AM	A_B: yes i checked it's .05

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 453 and 471 can be analyzed as follows. D_C shared the normality results and asked others' ideas related to the results (line 453). D_C indicated that she split data according to the condition (line 455) and explained that she had all results in one chart (line 458). These ideas of D_C can be regarded in *idea generation* phase. A_B asked whether the sigma value smaller than .5 results in the significance and non-normality (line 461). D_C confirmed this suggestion (line 462), which demonstrated the *idea connection* phase. H_K had same idea since he stated that the p value less than 0.5 means significant and non-normal (line 464) which also demonstrated the *idea connection* phase. D_C checked H_K's statement and corrected the p value as 0.05 (469), which is considered in *idea connection* phase.

In order to understand whether the data passed the normality test, D_C checked resources in the Internet and found out that - if the P value is greater than 0.05, the data passes; if the P value is less than or equal to 0.05, the data fails according to the test of normality (line 708, 709). H_K and A_B agreed with this explanation (line 710, 712). However, D_C was confused again since he noticed that the graphs and the chart indicate different normality results (line 713). H_K offered that they can consider skewness and kurtosis values (line 715) but D_C was confused again (line 716). In order to obtain outlier graphs, A_B asked the sub menu they will select within the explore menu (line 718). But he couldn't acquire response.

D_C asked meaning of dots and stars in box plots (line 719). A_B explained that they are outliers and there are related definitions for mild outlier and extreme outlier (line 720, 723). D_C understood that stars were extreme outliers (line 724). D_C said that she could not understand one part about box plots. More specifically, she asked whether they would consider the place of median while deciding whether the distribution is normal or not. Moreover, she asked if they are going to consider whiskers (line 726). A_B provided response by stating that box plots don't completely represent normality of the distribution (line 728). H_K accepted this explanation (line 729). D_C got confused again and offered the book explanation that box plots also explain the distribution (line 736). H_K explained that box plot explains at a glance but tests are generally preferred to check normality of distribution (line 738-740). Therefore, D_C asked the function of box plots (line 741). H_K replied and explained that box plot represents the distribution of a population, hence median line dots and outliers can be understood easily (line 742-745). From now on, the role of box plots was clear for D_C (line 746).

Line	Date	Post Time	Chat Message / Whiteboard Activity
708	11/7/2013	4:08 PM	D_C: yes :/ I am checking it from the net
709	11/7/2013	4:09 PM	D_C: answer the question whether the data passed the normality test. If the P value is greater than 0.05, the answer is Yes. If the P value is less than or equal to 0.05, the answer is No. it says..
710	11/7/2013	4:09 PM	H_K: yes
711	11/7/2013	4:09 PM	H_K: it is right
712	11/7/2013	4:10 PM	A_B: ok
713	11/7/2013	4:10 PM	D_C: but the graphs and the chart say different things?
714	11/7/2013	4:11 PM	D_C: and I remember that H_K's and my charts were the same
715	11/7/2013	4:13 PM	H_K: then we can consider skewness and kurtosis
716	11/7/2013	4:14 PM	D_C:I do not know, I wrote some interpretations but I am not sure
718	11/7/2013	4:30 PM	A_B: H_K did you get the outlier graphs from explore menu?
719	11/7/2013	4:32 PM	D_C: In box plots, what were the dots and stars, I cannot find it in my notes :/
720	11/7/2013	4:33 PM	A_B: they are outliers
721	11/7/2013	4:33 PM	A_B: i think that method is interquartile range
722	11/7/2013	4:34 PM	D_C: outliers but, there was a difference between dots and stars?
723	11/7/2013	4:34 PM	A_B: there was a definition: mild outlier and extreme outlier.
724	11/7/2013	4:34 PM	D_C: all right, stars were extreme outliers
725	11/7/2013	4:47 PM	A_B: i'm done for today, i have another quiz tomorrow. we can finish the missing parts tomorrow morning.
726	11/7/2013	4:47 PM	D_C:I could not understand one part about box plots. are we going to take the place of median into consideration to decide whether the distribution of normal or not? Or are we going to look at the whiskers?
727	11/7/2013	4:47 PM	D_C: yeah sure..
728	11/7/2013	4:48 PM	A_B:I believe box plots don't tell much about normality of the distribution
729	11/7/2013	4:48 PM	H_K: yes right
730	11/7/2013	4:49 PM	H_K: whisker is bigger than median line
731	11/7/2013	4:49 PM	H_K: white line
732	11/7/2013	4:49 PM	H_K: less than outlier
733	11/7/2013	4:49 PM	A_B: good night
735	11/7/2013	4:49 PM	D_C: good night A_B
736	11/7/2013	4:50 PM	D_C: But H_K, in the book, it says that box plots also explain the distribution :/
737	11/7/2013	4:50 PM	H_K: ok see you tomorrow
738	11/7/2013	4:50 PM	H_K: yes it explains at a glance
739	11/7/2013	4:51 PM	H_K: but many people use normality tests
740	11/7/2013	4:51 PM	H_K: for distribution
741	11/7/2013	4:51 PM	D_C: so what is the function of box plots?
742	11/7/2013	4:52 PM	H_K: It explains the distribution of a population
743	11/7/2013	4:52 PM	H_K: we can understand the median line
744	11/7/2013	4:52 PM	H_K: dots
745	11/7/2013	4:53 PM	H_K: and outliers easily
746	11/7/2013	4:53 PM	D_C: all right, I get it now.

According to the Progressive Knowledge Building Inquiry cycle, messages between lines 708 and 746 can be analyzed as follows. D_C explained the interpretation of p value(709), which demonstrated the *idea generation* phase. Other members agreed (710-712). Yet, D_C was confused since he recognized that the graphs and the chart result in different normality results (line 713). H_K suggested that they can consider skewness and kurtosis values (line 715), which illustrated the *idea generation* phase. D_C asked the definition of dots and stars in box plots (line 719). A_B indicated that they are outliers and there are definitions for mild outlier and extreme outlier (line 720, 723), which demonstrated the *idea generation* phase. D_C stated that she could not understand one part about box plots (line 726). A_B responded that box plots don't entirely indicate normality of the distribution (line 728), which demonstrated the *idea generation* phase. H_K agreed with this explanation (line 729). D_C experienced confusion and indicated the book explanation that box plots also explain the distribution (line 736). H_K stated that box plot explains at a glance but tests are usually preferred to check normality of distribution (line 738-740), which illustrated the *idea connection* phase. Hence, D_C asked the function of box plots (line 741). H_K explained that box plot demonstrates the distribution of a population, therefore median line dots and outliers can be understood easily (line 742-745), which illustrated the *idea connection* phase.

Wiki Reflection

The team provided the following output for the interpretation of normality test results: "In this normality test, it can be seen that except from the picture condition of TOH, task completion times in different conditions and puzzles are normally distributed. ($p>.05$). It means that the mean can be most appropriate one to summarize task completion time values in each puzzle and condition combination. On the other hand, in the picture condition of TOH, task completion time is not normally distributed and since it is not normally distributed and interval data, median is better to summarize task completion time values in each puzzle and condition combination." The interpretation demonstrated that the team correctly identified the p value and made an appropriate comparison among significance and p values.

Assignment-4

A_B had a question about the normal distribution as the requirement of the t-test. He asked whether data or differences should be normally distributed (line 75, 76). D_C thought that the requirement is normal distribution of data, but wasn't sure enough and offered to check (line 77, 78). Later on, H_K suggested that dependent variables should be normally distributed (line 79). Similarly, D_C indicated the normal distribution of data as the requirement. However, A_B experienced confusion: he offered that the difference between independent variables should be normal based on an explanation from the book (line 81, 84). On the other hand, D_C and H_K didn't have same idea as A_B (line 82, 83). H_K indicated the question as an example (line 85). He explained that groups are independent variables (line 86); pre-test and post-test scores are dependent variables. He offered to consider normality of test scores since they are dependent variables (line 91, 92). A_B understood the explanation and interpreted that dependent variables should be normal (line 93, 94) and others agreed (line 95, 96).

Line	Date	Post Time	Chat Message / Whiteboard Activity
75	12/5/2013	2:35 PM	A_B: i have a question about normal distribution
76	12/5/2013	2:36 PM	A_B: in t-test should data be normally distributed or the differences be normally distributed or both?
77	12/5/2013	2:36 PM	D_C: I think data..
78	12/5/2013	2:36 PM	D_C: hmm let me check
79	12/5/2013	2:37 PM	H_K: dependent variables should be normally distributed
80	12/5/2013	2:37 PM	D_C: yeah data
81	12/5/2013	2:38 PM	A_B: as well as the difference between independent variables, right?
82	12/5/2013	2:39 PM	D_C: actually I am not sure about the difference but I don't think so :/
83	12/5/2013	2:39 PM	H_K: no need
84	12/5/2013	2:39 PM	A_B: there is this sentence "The sampling distribution is normally distributed. In the dependent t-test this means that the sampling distribution of the differences between scores should be normal, not the scores themselves (see section 9.4.3)."
85	12/5/2013	2:39 PM	H_K: for instance in this question
86	12/5/2013	2:39 PM	H_K: groups are independent variables
87	12/5/2013	2:39 PM	D_C: but I think the difference of the scores in a one independent variable
88	12/5/2013	2:39 PM	H_K: such as gender
89	12/5/2013	2:39 PM	H_K: age or education level
90	12/5/2013	2:39 PM	D_C: not the difference between independent variables
91	12/5/2013	2:40 PM	H_K: we need to analyze pre-test and post-test scores
92	12/5/2013	2:40 PM	H_K: they are dependent variables
93	12/5/2013	2:40 PM	A_B: ok
94	12/5/2013	2:41 PM	A_B: so they should be normally distributed if we were to use t-test
95	12/5/2013	2:41 PM	D_C: yes
96	12/5/2013	2:41 PM	H_K: right

Analysis of the messages between lines 75 and 96 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. A_B asked whether data or differences should be normally distributed as the requirement of t-test (line 75, 76). D_C indicated that the requirement is normal distribution of data (line 77, 78), which is considered in *idea generation* phase. H_K proposed that dependent variables should be normally distributed (line 79), which demonstrated the *idea generation* phase. D_C indicated the normal distribution of data, which demonstrated the *idea generation* phase. Yet, according to A_B the difference between independent variables should be normal based on an explanation from the book (line 81, 84), which illustrated the *idea connection* phase. However, D_C and H_K had different ideas than A_B (line 82, 83). H_K suggested the question as an example (line 85). He stated that groups are independent variables (line 86); pre-test and post-test scores are dependent variables. Then, he suggested to consider normality of test scores since they are dependent variables (line 91, 92), which illustrated the

idea connection phase. A_B understood the explanation and interpreted that dependent variables should be normal (line 93, 94) and others agreed (line 95, 96).

Wiki Reflection

For the interpretation of the results, the team provided the following output: "Normality test is made without considering group information. The data from the variables PreTest and PostTest are considered as a whole. According to K-S test and S-W test, PreTest has non-normal ($p<.05$) and PostTest has normal ($p>.05$) distribution. As decided in the chat environment, the team examined the normality of test scores and provided appropriate reasoning.

Assignment-5

A_B indicated that the result becomes non-normal if they consider the listcount as whole (line 54). Actually, A_B was not sure if they should do grouping before the normality test (line 55). In order to learn the results when grouping is applied, D_C asked if A_B conducted such an analysis (line 57). A_B stated that he was working on this kind of analysis (line 59). D_C applied the normality test and stated that she found non normal results when grouped the data (line 60). On the other hand, A_B reached normal results with the same analysis (line 61). Therefore, D_C performed the analysis again (line 62), and then obtained the normal results as A_B (line 63, 64).

However, D_C wasn't confident enough for the necessity of grouping data, hence asked others if it is essential (line 65). As a response, A_B confirmed to apply grouping and shared a link of a web site that has a related explanation (line 66). H_K didn't apply the test for that time and asked the grouping variable they should consider (line 67). A_B replied that mood, and stop rule are grouping variables (line 68). A_B shared a statement that explains the normality requirements of the variables. That is, dependent variable should be approximately normally distributed for each combination of the groups of the two independent variables (line 69).H_K asked if mood or stop rule should be grouping variable (line 70), D_C responded that they should consider both variables separately (line 72).

A_B shared the normality results in the whiteboard area (line 73). D_C indicated the results that there is one non-normal case which is mood positive (line 78-80). Yet, H_K didn't have same idea with D_C. He interpreted that the result is significant with respect to S-W test whereas not significant with respect to K-S test (line 81-83). A_B had some questions. He firstly asked the appropriate test for their case. Then, he asked if normal results with respect to K-S test are enough for parametric anova (line 84). Both H_K and D_C replied that they should consider the results of K-S (line 85, 86). D_C stated that the results are normal and offered to apply Anova (line 87).

Line	Date	Post Time	Chat Message / Whiteboard Activity
53	12/21/2013	3:39 PM	A_B: yes, for
54	12/21/2013	3:39 PM	A_B: if we take listcount as whole it is non-normal
55	12/21/2013	3:40 PM	A_B: i'm not sure whether we should group then make the normality test
56	12/21/2013	3:39 PM	H_K: yeah right
57	12/21/2013	3:41 PM	D_C: how about the other situation? did you try it as grouping?
59	12/21/2013	3:41 PM	A_B: i'm now trying
60	12/21/2013	3:42 PM	D_C: I tried and as far as my results, they are not normal
61	12/21/2013	3:43 PM	A_B: when we group (all situations) i found that all are normal
62	12/21/2013	3:43 PM	D_C: hmm let me try it again
63	12/21/2013	3:43 PM	D_C: I think I made something wrong
64	12/21/2013	3:44 PM	D_C: all right they are normal now
65	12/21/2013	3:44 PM	D_C: so are we going to group them?
66	12/21/2013	3:46 PM	A_B: yes, check this: https://statistics.laerd.com/spss-tutorials/two-way-anova-using-spss-statistics.php
67	12/21/2013	3:46 PM	H_K: what is your variable to use grouping
68	12/21/2013	3:46 PM	A_B: both mood and stop_rule
69	12/21/2013	3:46 PM	A_B: Your dependent variable should be approximately normally distributed for each combination of the groups of the two independent variables.
70	12/21/2013	3:46 PM	H_K: mood or stop_rule
71	12/21/2013	3:47 PM	A_B: to get each combination i group them using both
72	12/21/2013	3:47 PM	D_C: they are both separately
73	12/21/2013	3:47 PM	A_B: let me share my output file
78	12/21/2013	3:48 PM	D_C: here, not all of them are normal :/
79	12/21/2013	3:48 PM	D_C: just one is not normal
80	12/21/2013	3:50 PM	D_C: mood positive, feel like continuing one
81	12/21/2013	3:51 PM	H_K: no Kolmogorov smirnov is significant
82	12/21/2013	3:52 PM	H_K: sorry Shapiro Wilk is significant
83	12/21/2013	3:53 PM	H_K: Kolmogorov smirnov is not significant
84	12/21/2013	3:53 PM	A_B: Well which one we can count on? Kolmogorov smirnov says its normal. by the way this should be enough for to make parametric anova i think, what do you say?
85	12/21/2013	3:53 PM	H_K: yes we should consider Kolmogorov smirnov test
86	12/21/2013	3:55 PM	D_C: yeah Kolmogorov smirnov test is okay
87	12/21/2013	3:56 PM	D_C: and they are normal so: anova

Based on the Progressive Knowledge Building Inquiry cycle, messages between lines 53 and 87 can be analyzed as follows. A_B stated that the data becomes non-normal if they consider the listcount as whole (line 54), which demonstrated the *idea generation* phase. However, he was not sure if they should apply grouping before the normality test (line 55). H_K agreed

with the result (56), D_C asked if others grouped data (57). While D_C had non-normal results (60), A_B found normal results (61) when applied grouping, which illustrated the *idea generation* phase. D_C conducted the analysis again and reached the normal results (62-64), which is considered in *idea connection* phase. Then, he asked if grouping is appropriate (65). A_B agreed with the grouping by providing a related web source (66), which demonstrated the *idea improvement* phase. H_K asked the variable of grouping, other members responded that they used both mood and stop rule.

A_B shared the normality results in the whiteboard area (line 73). D_C interpreted that there is one non-normal case which is mood positive (line 78-80), which demonstrated the *idea generation* phase. However, H_K didn't think like D_C: he indicated that the result is significant with respect to S-W test and not significant with respect to K-S test (line 81-83), which illustrated the *idea connection* phase. A_B asked the required test for their case and if normal results with respect to K-S test are enough for parametric anova (line 84). Both H_K and D_C replied that they should consider the results of K-S (line 85, 86), which illustrated the *idea connection* phase. D_C interpreted that the results are normal and suggested to apply Anova (line 87),which demonstrated the *idea generation* phase.

Wiki Reflection

In the chat environment the team decided to consider mood and stop_rule as grouping variables. This judgment was reflected to the wiki environment in the same way. That is, the team reported that "We organized our data as two grouping variables and one dependent variable:'mood' and 'stop_rule' are grouping variables. 'mood' has three values: 1 - Negative, 2 - Positive, 3 - Neutral and 'stop_rule' has two values: 1 - as many as you can, 2 - feel like continuing."

The interpretation was done in terms of K-S test in the chat environment. The same attitude was also observed in the wiki output. The team considered the results of K-S test and found the results normal.

Assignment-6

H_K explained that they need normality and sphericity results for the question e (line 55), and D_C accepted this offer (line 56). D_C asked the way of defining factors in the repeated measure design (line 57) since she experienced confusion about this issue(line 59). H_K replied that there are three factors and suggested to define them (line 60). Then, H_K shared the normality and sphericity results in the whiteboard area. About the normality test results, H_K stated that the sample size is less than 50,hence they can consider results of the s-w test (line 62). D_C reviewed the results and interpreted that the 2^{nd} condition is not normally distributed (line 64).

However, H_K recognized that he had made a mistake while creating the data set (line 68). He stated that data of the 12^{th} participant for Condition 2 should be 26 (line 69). He explained that it was a hypo (line 70) and asked D_C to correct it (line 71). Then, H_K shared the revised normality results in the whiteboard area. D_C interpreted that all data were normal at that time (line 77).

About the question e, A_B stated that he noticed the normality results, which were previously shared by H_K (line 162). A_B expected confirmation for the use of s-w test.

But, he wanted to understand if the reason of use was sample size in their data set (line 163). H_K provided agreement to the reason provided by A_B (line 165).

Line	Date	Post Time	Chat Message / Whiteboard Activity
55	12/30/2013	3:55 PM	H_K: question e, we need sphericity test and normality tests results
56	12/30/2013	3:56 PM	D_C: yes
57	12/30/2013	3:57 PM	D_C: how do we define factors in repeated measure?
59	12/30/2013	3:58 PM	D_C: I could not understand
60	12/30/2013	3:58 PM	H_K: we have three factors so define three
61	12/30/2013	3:59 PM	D_C: hmm all right
62	12/30/2013	4:00 PM	H_K: as we know that sample size is 18 and less than 50 , Shapiro Wilk tests is ok
63	12/30/2013	4:00 PM	D_C: yes, small number
64	12/30/2013	4:00 PM	D_C: so here, spherecity is violated right?
65	12/30/2013	4:01 PM	D_C: and condition 2 is not normal?
67	12/30/2013	4:01 PM	D_C: all the time I mix the value of normality up :/
68	12/30/2013	4:02 PM	H_K: yeah I made a mistake when I typed the data
69	12/30/2013	4:02 PM	H_K: at Condition 2 , participant 12, data should be 26
70	12/30/2013	4:02 PM	H_K: but I made a typo
71	12/30/2013	4:03 PM	H_K: If you open the data, could you change that
72	12/30/2013	4:03 PM	D_C: condition 1 and 2?
73	12/30/2013	4:03 PM	H_K: subject number 12, condition 2
75	12/30/2013	4:03 PM	D_C: all right :)
77	12/30/2013	4:05 PM	D_C: yeah now they are normal
78	12/30/2013	4:06 PM	H_K: yeah , thanks for parametric assumptions :D
79	12/30/2013	4:07 PM	D_C::D
162	01/02/2014	4:44 PM	A_B: ok in e i saw your normality test results
163	01/02/2014	4:45 PM	A_B: we can rely on Shapiro Wilk in this dataset. is this because of sample size? i remember you mentioned this.
165	01/02/2014	4:47 PM	H_K: yeah right
166	01/02/2014	4:47 PM	H_K: I remember like that

Messages between lines 55 and 166 can be analyzed according to the Progressive Knowledge Building Inquiry cycle as follows. H_K proposed that they need normality and sphericity results for the question e (line 55), which illustrated the *idea generation* phase. D_C asked the way of defining factors in the repeated measure design (line 57). H_K responded that there are three factors and offered to define them (line 60), which demonstrated the *idea generation* phase. After that, H_K shared the normality and sphericity results in the whiteboard area. For the normality, H_K indicated that the sample size is less than 50, so they can consider results of the s-w test (line 62),which is considered in *idea generation* phase. D_C checked the results and interpreted that the 2nd condition is not normally distributed (line 64), which illustrated the *idea connection* phase. H_K recognized that he made a mistake while generating the data set (line 68) and asked D_C to correct it

(line 71). Then, H_K shared the revised normality results in the whiteboard area. D_C interpreted that all data were normal at that time (line 77).

Wiki Reflection

In the chat environment, the team decided to consider the results of S-W test and found the conditions normal. This solution was reflected to the wiki output in the same way – 'According to S-W results, data set is normally distributed ($p>0.05$). Sample size is small so we can consider Shapiro-Wilk test results.'

Assignment-7

D_C stated that she was searching for the way of applying the normality test in the SPSS environment (line 39). H_K listed the steps as Analyze > Descriptive >Explore (line 40). However, D_C actually asked whether they put variables separately or just all of them to the category of dependent variables (line 41). H_K understood and suggested to put the years variable to the factor list (line 42). D_C indicated that she shared the normality results in the whiteboard and asked if they were correct (line 43, 44). H_K agreed with results and suggested D_C to share them in the wiki (line 47 48). D_C shared the results and interpreted that all are normal (line 58).

Line	Date	Post Time	Chat Message / Whiteboard Activity
39	01/09/2014	3:37 PM	D_C: I was looking for how can I do the normality test
40	01/09/2014	3:38 PM	H_K: Analyze > Descriptive > Explore
41	01/09/2014	3:40 PM	D_C: no, are we putting them separately or just all of them in dependent variables
42	01/09/2014	3:44 PM	H_K: Yeah and years to Factor list
43	01/09/2014	3:45 PM	D_C: all right. then I have this
44	01/09/2014	3:45 PM	D_C: is it okay then?
47	01/09/2014	3:52 PM	H_K: yeah
48	01/09/2014	3:52 PM	H_K: could you paste it to wiki
49	01/09/2014	3:52 PM	D_C: yeah sure
58	01/09/2014	4:06 PM	D_C: so they are all normal

Analysis of the messages between lines 39 and 58 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. D_C asked the way of applying the normality test (39, 41). H_K explained the steps that they should follow (40, 42), which demonstrated the *idea generation* phase. D_C applied the test and found the results (43, 44), which illustrated the *idea connection* phase.

Wiki Reflection

The team found the cases normal in the chat environment.

Experience of the Team throughout Assignments

In the initial assignment, the team faced with the problem of interpreting the p value. One of the members had confusion and directly asked the role of p value in the normality test. The others provided examples and clarifications that became helpful for the understanding related to the interpretation of p value. Therefore, in the remaining assignments, the team didn't have any challenge about this issue.

The team shared the knowledge while deciding on suitability of k-s or s-w test for the cases in the assignments. In the first assignment, the team planned to consider the results of k-s test while checking the normality of data. They didn't indicate any reasoning for their choice. In the fifth assignment, the team discussed that whether s-w or k-s test was appropriate for the data. Then, based on the results provided by tests, the team decided to consider the k-s as the appropriate test. In the sixth assignment, the team demonstrated maturity during the process of identifying the test. They offered the use of s-w test based on the sample size in the dataset.

The other concern of the team was about applying the steps of the normality test in a proper way. In the first and fifth assignment, the team discussed about the suitable grouping variable for the dataset. With the share of opinions, the team came to an agreement. In the seventh assignment, the team's problem was about deciding on the steps of the normality test in the SPSS environment. The transfer of knowledge among members solved the problem and the team could apply the test and obtain the proper results.

Individual Progress of Team Members

A_B: In the first assignment, A_B offered to consider normality results belong to k-s test and interpret the sigma value. This suggestion was accepted by other members. However, he had lack of knowledge about the role of the sigma value in the normality test. Other members provided explanations to enable understanding of A_B. After that, a discussion occurred about the grouping variable for the normality test. H_K stated that the grouping was done according to the condition. However, A_B offered to group data by considering both puzzle and condition, which was a correct solution. D_C had lack of understanding about dots and stars in box plots, and the role of box plots in normality test. A_B provided appropriate explanations.

In the fourth assignment, A_B had confusion whether data or differences should be normally distributed as the requirement of the t-test. With the explanations of team members, he understood that dependent variables should be normal.

In the fifth assignment, A_B was more confident in applying the normality test. He suggested the correct grouping variables and provided explanations to other members. He also shared the results of normality test. However, he experienced confusion in deciding the test they should consider. With the explanations of team members, he could understand they should interpret the results of k-s test. In the sixth assignment, the progress of A_B was observed in identifying the appropriate test. He correctly stated that the s-w test is appropriate because of the sample size.

D_C: In the first assignment, D_C offered to consider the k-s test and shared the results of the normality test. Then, the group noticed that they should group the data before applying the normality test. Therefore, she reapplied the test and shared the corrected results. In order to understand whether the data passed the normality test, D_C checked resources in the Internet and found out that - if the P value is greater than 0.05, the data passes; if the P value is less than or equal to 0.05, the data fails according to the test of normality. Others agreed with this explanation. Yet, D_C was confused again since he recognized that the graphs and the chart indicate different normality results. He asked the role of box plots in the normality test. H_K explained that box plot represents the distribution of a population, hence median line dots and outliers can be understood easily. From now on, the role of box plots was clear for D_C.

In the fourth assignment, A_B had confusion whether data or differences should be normally distributed as the requirement of the t-test. D_C made clarifications and explained that dependent variables should be normal.

In the fifth assignment, D_C applied the normality test and stated that she found non normal results when grouped the data. Yet, A_B obtained normal results when employed the same analysis. Thus, D_C performed the analysis again and found the normal results as A_B.

In the sixth assignment, D_C experienced problem of defining factors in the repeated measure design. H_K replied that there are three factors and suggested to define them. H_K shared the results of normality test, and D_C provided correct interpretations.

In the seventh assignment, D_C expected to understand the way of categorizing factors while applying the normality test. By the help of H_K, she could employ the test and interpret the results correctly.

H_K: H_K generally adopted the guide role in the assignments. In the first assignment, H_K provided explanations to facilitate other members' understanding related to interpretation of sigma value.

In the fourth assignment, A_B had confusion whether data or differences should be normally distributed as the requirement of the t-test. H_K provided examples and explained that dependent variables should be normal.

In the fifth assignment, A_B experienced problem in considering results of k-s or s-w test. H_K stated that they should consider results of k-s test.

In the sixth assignment, D_C asked the way of defining factors in the repeated measure design. H_K replied that there are three factors and suggested to define them. Then, H_K shared the normality and sphericity results in the whiteboard area. About the normality test results, H_K stated that the sample size is less than 50, hence they can consider results of the s-w test.

In the seventh assignment, D_C expected to understand the way of categorizing factors while applying the normality test. By the help of H_K, she could employ the test and interpret the results correctly.

OTHERCONCEPTS

ASSIGNMENT-3

A researcher has asked a sample of voters in a country to rate their support for the current government (status quo), their educational level, age, gender, annual income, and whether they will vote Yes or No in an upcoming referendum. 1757 of the interviewees agreed to declare their vote. The dataset is provided in Voting.sav file.

Conduct a logistic regression analysis on this data to see which factors might be useful for predicting voting behavior in this country. In particular, construct separate models where:

i) age is the only predictor
ii) government support is the only predictor
iii) a model including all variables with Backward:Wald as the data entry method.

For each model answer the following questions by first providing a copy of the relevant table from the SPSS output:

a. Is this model a significant fit to the data? Why or why not?

b. What's the equation for the model?

c. How does the prediction power of the model compare to the baseline model?

d. Is/are the predictor variable(s) making a significant contribution to the prediction of the outcome? Why or why not?

e. What is the odds ratio value in this model? What does it tell you about the model (i.e. provide a verbal description of what it implies about the data)?

f. Does the confidence interval of a predictor in the model include the value 1? What would be the issue if the confidence interval includes 1?

Significance of the model

The team initiated the discussion about the question a. A_B firstly asked the appropriate parameter to be used while checking significance of the model. Then, he suggested the R statistics for the purpose of conducting the checking process. H_K provided confirmation to the offer of A_B. Then, H_K asked if Cox & Snell's or Nagelkerke's results were appropriate in this context. As a response, A_B suggested considering results belong to Nagelkerke.

A_B and H_K performed the analysis and found the nagelkerke value as 0.31. By considering the interval of -1 1, A_B interpreted that the model wasn't significant for age.

A_B asked the way of interpreting results. H_K responded and then interpreted the chi square as 41,397. In addition, he interpreted the 6% difference as a good sign and significant. On the other hand, A_B confused about these interpretations, and offered to interpret

nagelkerke according to wald statistics. However, that part was not very clear for A_B. For the purpose of providing explanations, H_K stated that wald is about the variable itself, not model, model can be poor fit but significant. In this way, A_B gained understanding.

In the remaining chat session, H_K suggested to export outputs for all models. For the model i, A_B interpreted that model is significant but does not have much prediction power. H_K agreed with the significance part, but proposed to interpret the prediction in the following section of the question. According to A_B, providing output is trivial process and for interpretation part they should consider cross-relations. For the interpretation, they decided to organize the whiteboard area in order to facilitate the process.

Line	Date	Post Time	Chat Message
14	11/23/2013	3:52 PM	H_K: Let's start with the a
15	11/23/2013	3:52 PM	A_B: Ok
16	11/23/2013	3:53 PM	A_B: which parameter should we use for significance of the model?
17	11/23/2013	3:54 PM	A_B: the R statistics, right?
18	11/23/2013	3:54 PM	H_K: yes
19	11/23/2013	3:55 PM	A_B: ok for i I'll try to create a result
20	11/23/2013	3:55 PM	H_K: Cox & Snell's or Nagelkerke's
21	11/23/2013	3:55 PM	H_K: Cox & Snell's or Nagelkerke's
22	11/23/2013	3:55 PM	A_B: from results table we can discuss r-statistics
23	11/23/2013	3:55 PM	A_B: or do you have any results?
24	11/23/2013	3:55 PM	A_B: already
25	11/23/2013	3:56 PM	H_K: No I haven't started yet
26	11/23/2013	3:56 PM	H_K: Ok I will
27	11/23/2013	4:00 PM	A_B: ok in the result i found nagelkerke (i think this is the one we should use) is 0.31
28	11/23/2013	4:00 PM	A_B: sorry 0.0331
29	11/23/2013	4:00 PM	A_B:.031 :)
30	11/23/2013	4:01 PM	A_B: if we consider the interval of -1 1
31	11/23/2013	4:01 PM	A_B:.031 is very small
32	11/23/2013	4:02 PM	A_B: we can interpret that this model is not a significant one
33	11/23/2013	4:02 PM	H_K: yes this is for age
34	11/23/2013	4:02 PM	H_K: right ?
35	11/23/2013	4:02 PM	A_B: yes this is for age
36	11/23/2013	4:03 PM	H_K: Let me get my output then interpret for age
37	11/23/2013	4:04 PM	A_B: Ok
38	11/23/2013	4:08 PM	H_K: ok I got the same results
39	11/23/2013	4:10 PM	A_B: what do you think about the interpretation part?

40	11/23/2013	4:11 PM	H_K: this chi-square results model is significant
41	11/23/2013	4:12 PM	H_K: 41.397 this is the difference from initial baseline model
42	11/23/2013	4:13 PM	A_B: what does 41.397 tell us? its residual right? how can we interpret that number?
43	11/23/2013	4:15 PM	A_B: to my understanding we can use nagelkerke r square to understand how well the model fit the data
44	11/23/2013	4:15 PM	H_K: Classification table shows the improvement in prediction %50
45	11/23/2013	4:15 PM	H_K: to %56
46	11/23/2013	4:18 PM	H_K: I think if 41,397 difference is a good sign instructor mentioned in the slides, and it is significant
47	11/23/2013	4:19 PM	H_K: we can say that it is a good fit
48	11/23/2013	4:19 PM	A_B: him
49	11/23/2013	4:20 PM	A_B: but the difference is only %6
50	11/23/2013	4:20 PM	A_B: actually bigger than 0 :)
51	11/23/2013	4:21 PM	A_B: but the r square value confuses me
52	11/23/2013	4:21 PM	A_B: it's very low
53	11/23/2013	4:21 PM	H_K: right
54	11/23/2013	4:21 PM	H_K: 31%
55	11/23/2013	4:21 PM	H_K: not bad
56	11/23/2013	4:22 PM	A_B: no in logistic regression we cannot say that
57	11/23/2013	4:22 PM	A_B: this is little different
58	11/23/2013	4:22 PM	A_B: Wait
59	11/23/2013	4:22 PM	A_B: see the section 8.3.2 in the textbook
60	11/23/2013	4:23 PM	H_K: Wald 40,397
61	11/23/2013	4:23 PM	A_B: take your time
62	11/23/2013	4:29 PM	A_B: H_K This part takes our time
63	11/23/2013	4:29 PM	H_K: lets says significant according to chi-square
64	11/23/2013	4:31 PM	A_B: are you sure about that? I am asking because i have no idea of interpreting chi square for logistic regression.
65	11/23/2013	4:32 PM	A_B: or are there anything you can offer me to read for this chi square?
66	11/23/2013	4:33 PM	H_K: slide number 37
67	11/23/2013	4:37 PM	A_B: yeah i see in the summary part.
68	11/23/2013	4:38 PM	A_B: i think we should interpret nagelkerke according to wald statistics but that part is not very clear for me.
69	11/23/2013	4:39 PM	H_K: wald is about the variable itself
70	11/23/2013	4:39 PM	H_K: not model
71	11/23/2013	4:40 PM	H_K: model can be poor fit but significant
72	11/23/2013	4:40 PM	A_B: him
73	11/23/2013	4:40 PM	A_B: Right

74	11/23/2013	4:42 PM	A_B: ok this inference leads us to question c actually
75	11/23/2013	4:42 PM	H_K: exactly
76	11/23/2013	4:42 PM	H_K: what we should do today is
77	11/23/2013	4:43 PM	H_K: we should export the output for all predictors I mean a, b and c models
78	11/23/2013	4:44 PM	H_K: then interpret all questions
79	11/23/2013	4:45 PM	A_B: so for i we can say that model is significant but does not have much prediction power
80	11/23/2013	4:46 PM	H_K: we can say it is significant ($p<0.05$)
81	11/23/2013	4:47 PM	H_K: it is enough we discuss the prediction in c or d
82	11/23/2013	4:53 PM	A_B: ok, according to your guiding i'll need time to get the whole picture. the output part is trivial. we can do it in half an hour. but for interpretation part we should consider cross-relations(i think).
83	11/23/2013	4:54 PM	H_K: Ok lets open new tabs for i , ii and iii
84	11/23/2013	4:54 PM	H_K: then try to interpret easily
85	11/23/2013	4:54 PM	A_B: Ok

Messages between lines 14 and 73 can be analyzed according to the Progressive Knowledge Building Inquiry cycle as follows. Initial message of H_K aims to start to the question a, which can be considered as trigger activity that encourages learners to provide solutions. A_B offered to employ R statistic (17), which demonstrated the *idea generation* phase. Between lines 27 and 35, he explained that he found the nagelkerke value as 0.0331, and interpreted the model with age not significant, which can be considered in *idea generation* phase. H_K reached the same results (38). A_B asked how they can perform the interpretation (39). H_K interpreted the chi square as 41,397 (41) and the 6% difference as a good sign and significant (46), which demonstrated the *idea generation* phase. On the other hand, A_B confused about the interpretations, and suggested to interpret nagelkerke r value according to wald statistics (48-52). In order to provide explanations, H_K indicated that wald is about the variable, not the model (69-71), which demonstrated the *idea connection* phase. In this way, A_B gained understanding (72, 73).

Interpretation

A_B initially asked the reason of existence of 0 values in the classification table. At the same time, he proposed two reasons as existence of constant in the equation or no(zero) value provided by the log of constant. Since H_K indicated his lack of understanding in this issue, A_B attempted to gain understanding. He stated that if they only have constant value in equation, then constant would be .024 and this would give the no answer. He also indicated that if they had age in the equation score would be 41.

A_B interpreted the overall increase in percentage as 6.5 %. But he stated that he couldn't interpret chi-square part. For the purpose of interpretation, H_K explained that "In the initial model -2 log likelihood is 2435,468 then when the age used to predict new -2 log likelihood is 2394,082, so chi-square is the difference between those -2 log likelihood -41,397". After this explanation, A_B interpreted that "when age is in the equation we can predict more

accurately because -2LL decreased" and it is significant. As a result, H_K provided confirmations to these interpretations.

Line	Date	Post Time	Chat Message
123	11/23/2013	5:05 PM	A_B: so for i
124	11/23/2013	5:05 PM	A_B: classification table
126	11/23/2013	5:06 PM	A_B: why does yes column have 0 values?
128	11/23/2013	5:08 PM	A_B: is it because we have only constant in the equation?
130	11/23/2013	5:11 PM	A_B: and the log of that constant always give no(zero) value
131	11/23/2013	5:13 PM	H_K: himm.. I couldn't understand that tale
132	11/23/2013	5:13 PM	H_K: table
133	11/23/2013	5:14 PM	A_B: ok i got it let me tell you if that's plausible, i'll add detailed table as you did
135	11/23/2013	5:15 PM	A_B: ok lets move on to the tab i-2
136	11/23/2013	5:16 PM	A_B: if we have only the constant in our equation
137	11/23/2013	5:16 PM	A_B: constant would be -.024
138	11/23/2013	5:17 PM	A_B: and this would give us only NO answer(0 or very close probability to 0)
139	11/23/2013	5:17 PM	A_B: so the baseline is 50%
140	11/23/2013	5:18 PM	A_B: and "variables not in the equation" table tells us
141	11/23/2013	5:19 PM	A_B: id we had age in the equation score would be 41... (i'm not sure about the score unit but it's explained in the textbook)
142	11/23/2013	5:19 PM	A_B: and age would be significant
143	11/23/2013	5:20 PM	A_B: we moved to step 1 which means added age to the equation
144	11/23/2013	5:21 PM	A_B: our final coefficients in the table "iteration history"
145	11/23/2013	5:21 PM	A_B: constant=-.814 age=.021
146	11/23/2013	5:23 PM	A_B: ok now
147	11/23/2013	5:24 PM	A_B: our new classification table shows us that overall percentage is increased by 6,5%
148	11/23/2013	5:24 PM	A_B: by adding age variable as predictor
149	11/23/2013	5:25 PM	A_B: but i cannot interpret chi-square part (i now it's significant and i know it's residual)
152	11/23/2013	5:27 PM	H_K: In the initial model
153	11/23/2013	5:29 PM	H_K: -2 log likelihood is 2435,468 then when the age used to predict new -2 log likelihood is 2394,082
154	11/23/2013	5:29 PM	H_K: so chi-square is the difference between those -2 log likelihood
155	11/23/2013	5:29 PM	H_K: 41397
156	11/23/2013	5:30 PM	A_B: "At this stage of the analysis the value of -2LL should be less than the value when only the constant was included in the model (because lower values of -2LL indicate that the model is predicting the outcome variable more accurately)."

157	11/23/2013	5:31 PM	A_B: so when age is in the equation we can predict more accurately because -2LL decreased
158	11/23/2013	5:31 PM	H_K: right
159	11/23/2013	5:32 PM	A_B: and this is significant as we see in omnibus table
160	11/23/2013	5:33 PM	H_K: right

Based on the Progressive Knowledge Building Inquiry cycle, messages between lines 123 and 160 can be analyzed as follows. In the initial message, A_B asked the reason of existence of 0 values in the classification table. He suggested two possible reasons: existence of constant in the equation (128), no(zero) value provided by the log of constant (130), which demonstrated the *idea generation* phase. Yet, H_K couldn't understand this issue (131). A_B attempted to gain understanding. Between lines 135 and 141, he stated that if they only have constant value in equation, then constant would be .024 and this would give the no answer. He also indicated that if they had age in the equation score would be 41. His attempts can be considered in *idea improvement* phase. A_B interpreted the overall increase in percentage as 6.5 % (147). However, he stated that he couldn't interpret chi-square part (149). Between lines 152 and 155, H_K explained that "In the initial model -2 log likelihood is 2435,468 then when the age used to predict new -2 log likelihood is 2394,082, so chi-square is the difference between those -2 log likelihood -41,397", which demonstrated the *idea generation* phase. Based on this explanation, A_B provided the interpretation that "when age is in the equation we can predict more accurately because -2LL decreased" and it is significant. These understandings can be considered in *idea connection* phase.

ASSIGNMENT-4

A study of reading comprehension in children compared three methods of instruction. First, all participants' reading comprehension levels were assessed with a pre-test. Then, participants were split into 3 groups, where they were exposed different methods of instruction to develop their reading comprehension skills. Finally, all group members were given a post-test that is comparable to the pre-test in terms of content. The data for the study is stored in reading.sav file.

1. Identify the dependent and independent variables of this study. At what level of scale each variable is measured?

2. Are the dependent variables normally distributed? Do they satisfy homogeneity of variance? Perform the appropriate tests in SPSS and report their results (Note: use the appropriate group level for these tests. You should keep in mind the comparisons you will do in the next questions)

3. Focus on the pre-test results only. Draw a bar chart with 95% confidence intervals. Is there a difference among the groups? Which test would be appropriate to test whether there is a statistically significant difference among the groups and why? What is the null hypothesis? Do the test and report the test results (you should use the reporting guidelines in the book). If there is an overall difference, which pair

of groups differ from each other? Again, explain what statistical test you are using to make that argument.

4. Next, focus on the post-test results. Draw a bar chart with 95% confidence intervals. Is there a difference among the groups? Which test would be appropriate to test whether there is a statistically significant difference among the groups and why? What is the null hypothesis? Do the test and report the test results (you should use the reporting guidelines in the book). If there is an overall difference, which pair of groups differ from each other? Again, explain what statistical test you are using to make that argument.

5. Finally, focus on each instruction group separately. Which test should you use to compare the difference between the pre and post test scores of each student in each instruction group? Do the appropriate test(s) and report the results in the formal reporting format.

In this chat segment, the team performed a talk about the background knowledge appropriate for conducting the analysis in the assignment.

The talk was initiated about the t-test and its types. H_K reminded the purpose of the t-test as the comparison of two groups, and indicated its types as independent and dependent. He then explained the use of independent t-test for comparing two independent groups and indicated the important requirement for applying t-test. That is, dependent variables should be normally distributed since t-test has parametric characteristics. After this explanation, A_B indicated that t-test has non parametric versions. H_K had already knowledge, hence stated that mann whitney as the non parametric independent t-test, and Wilcoxon as paired t test.

A_B expected to understand the relation between t-test and anova. As a response, D_C attempted to indicate the difference between these two tests. Therefore, she explained that while t-test is used for comparison of two groups, anova is used for more than two groups. H_K provided confirmation to this explanation.

Line	Date	Post Time	Chat Message
50	12/05/2013	2:29 PM	H_K: we use t-test if we have only two groups
51	12/05/2013	2:29 PM	H_K: there are type of t-test
52	12/05/2013	2:29 PM	H_K: independent and dependent
53	12/05/2013	2:29 PM	H_K: if we compare two independent group
54	12/05/2013	2:29 PM	H_K: we need to use independent t-test
55	12/05/2013	2:30 PM	A_B: if it's not we use non parametric versions
56	12/05/2013	2:30 PM	H_K: but first of all dependent variables should be normally distributed
57	12/05/2013	2:30 PM	H_K: because t-test is parametric test
58	12/05/2013	2:30 PM	H_K: right
59	12/05/2013	2:31 PM	H_K: independent t-test >>mannwhitney
60	12/05/2013	2:31 PM	D_C: I think we are not going to be responsible for nonparametric tests tomorrow. right?

61	12/05/2013	2:31 PM	H_K: paired t test- wilcoxon
62	12/05/2013	2:31 PM	H_K: I don't know
63	12/05/2013	2:31 PM	A_B: we are responsible i think
64	12/05/2013	2:32 PM	D_C: all right, it is not so difficult :)
65	12/05/2013	2:32 PM	A_B: ok what about the relationship between t-test and anova
66	12/05/2013	2:32 PM	H_K: yeah
67	12/05/2013	2:32 PM	D_C: if we compare two groups, it is t-test
68	12/05/2013	2:32 PM	D_C: if we compare more than two means
69	12/05/2013	2:33 PM	D_C: it is anova as far as I know
70	12/05/2013	2:33 PM	H_K: absolutely

Analysis of the messages between lines 50 and 70 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. Between lines 50 and 61, H_K indicated the use of t-test and its types, which demonstrated the *idea generation* phase. D_C thought that they are not responsible for nonparametric tests (60). Although H_K didn't have idea (62), A_B thought that they were going to apply nonparametric test (63). A_B asked the relation between t-test and anova(65). Between lines 67 and 69, D_C provided appropriate explanations, which demonstrated the *idea connection* phase.

Deciding on Tests to be used

At the beginning of the talk, A_B proposed to identify the methods they should apply in solving questions of the fourth assignment.

As the solution of the first question, H_K offered the variables in the study. That is, he stated that pretest and post test scores are dependent, and group is independent variable. D_C and A_B provided confirmation to these suggestions.

Then, D_C indicated that they should consider homogeneity of variance while selecting parametric or non-parametric test. As the solution of second question, H_K interpreted that the pretest scores as non-normal and post test scores as normal. D_C offered to apply anova for post test scores, and kruskal wall is for pretest scores. Although D_C initially offered to consider homogeneity of variance while selecting parametric or non-parametric test, she suggested this idea based on normality test results, which was more appropriate behavior.

For the question 5, A_B offered to use non parametric independent version of t-test while comparing pre and post results. His reasoning related to this offer is that one test is normally distributed and the other one is not. On the other hand, H_K offered to apply paired t-test in question 5. A_B agreed and suggested to apply 3 different paired test, which should be nonparametric ones. H_K indicated that they can apply non parametric tests if pre-test or post-test are not normally distributed. Yet, he indicated the strength of t-test compared to non parametric one (i.e. wilcoxon) based on experience of researchers.

According to the decisions of the team, H_K listed the steps they should follow in solving question 5:

- Splitting data to analyze groups separately,
- Checking normality of groups,
- Deciding to apply paired t-test or non parametric wilcoxon test
- Considering significance in paired t-test results
- Checking asymmetric significance in Wilcoxon test

Other members provided confirmations to these steps.

Line	Date	Post Time	Chat Message
97	12/05/2013	2:41 PM	D_C: so from which one shall we start?
98	12/05/2013	2:42 PM	A_B: i think we should talk about the methods we use
99	12/05/2013	2:42 PM	A_B: later (maybe tomorrow) we can solve questions
100	12/05/2013	2:43 PM	D_C: tomorrow, I am going to be at home late. If I catch you, I can join
101	12/05/2013	2:42 PM	ok
102	12/05/2013	2:43 PM	H_K: 1. dependent >> pre-test and post-test independent > group
103	12/05/2013	2:43 PM	D_C: yes
104	12/05/2013	2:44 PM	A_B: ok
105	12/05/2013	2:44 PM	D_C: actually the rest depends on the homogeneity. right?
106	12/05/2013	2:44 PM	D_C: if they are homogeneous, parametric. ANOVA
107	12/05/2013	2:46 PM	A_B: yes
108	12/05/2013	2:46 PM	H_K: 2. pre-test scores are not normally distributed
109	12/05/2013	2:46 PM	H_K: post-test scores are normally distributed
110	12/05/2013	2:47 PM	D_C: hmm so for post test anova, for pretest kruskal wallis?
111	12/05/2013	2:47 PM	A_B: him
112	12/05/2013	2:47 PM	H_K: Right
113	12/05/2013	2:47 PM	D_C: I got happy before the quiz :)
114	12/05/2013	2:49 PM	A_B: ok for 5 we compare pre and post results since one is normally distributed and one is not we'll use non parametric independent version of t-test
115	12/05/2013	2:50 PM	H_K: actually we need to analyze them again separately
116	12/05/2013	2:50 PM	H_K: then paired t -test should be used
117	12/05/2013	2:51 PM	A_B: 3 different paired test
118	12/05/2013	2:51 PM	H_K: since we compare the same group
119	12/05/2013	2:51 PM	A_B: ?
120	12/05/2013	2:51 PM	H_K: right for 1 , 2 and 3
121	12/05/2013	2:51 PM	D_C: yes
122	12/05/2013	2:52 PM	A_B: and these will be non-parametric
123	12/05/2013	2:52 PM	H_K: wilcoxon
124	12/05/2013	2:52 PM	H_K: if pre-test or post-test are not normally distributed
125	12/05/2013	2:53 PM	H_K: but in most case , t-test is stronger than wilcoxon so
126	12/05/2013	2:53 PM	H_K: researchers support t-test and do not criticize

127	12/05/2013	2:53 PM	A_B: even if distribution is not normal?
128	12/05/2013	2:53 PM	H_K: yeah
129	12/05/2013	2:54 PM	A_B: interesting
130	12/05/2013	2:54 PM	D_C: so we are going to have ANOVA, t test, kruscal wallis and t test again for the nonparametric one?
131	12/05/2013	2:54 PM	H_K: yeah I saw some examples
132	12/05/2013	2:54 PM	H_K: in some thesis
133	12/05/2013	2:55 PM	H_K: yeah for 5 we need split data first to analyze groups separately
134	12/05/2013	2:55 PM	H_K: then see which one is not normally distributed
135	12/05/2013	2:56 PM	H_K: then decide to use parametric paired t-test or
136	12/05/2013	2:56 PM	H_K: non parametric wilcoxon test
137	12/05/2013	2:56 PM	H_K: in paired t-test results we should consider sig. which is p value
138	12/05/2013	2:57 PM	H_K: on the other side , we should consider asymmetric significance in wilcoxon
139	12/05/2013	2:57 PM	D_C: all right
140	12/05/2013	2:57 PM	A_B: great

Messages between lines 97 and 140 can be analyzed according to the Progressive Knowledge Building Inquiry cycle as follows. H_K offered the tests they should apply (102), which illustrated the *idea generation* phase. Other members agreed (103, 104). D_C proposed to apply anova, if the data is homogenious (105, 106), which can be considered in *idea generation* phase. For the solution of the 2ndquestion, H_K interpreted that the pretest scores as non-normal and post test scores as normal (108, 109), which demonstrated the *idea generation* phase. Based on these results, D_C proposed to apply anova for post test scores, and kruskal wallis for pretest scores (110), which illustrated the *idea connection* phase.

For the question 5, A_B suggested to employ non parametric independent version of t-test while comparing pre and post results (114), H_K proposed to apply paired t-test(116), which demonstrated the *idea generation* phase. A_B agreed and suggested to apply 3 different paired test (117), which illustrated the *idea connection* phase. H_K stated that they can employ non parametric tests if pre-test or post-test are not normally distributed. Moreover, he indicated the strength of t-test compared to non parametric one (i.e. wilcoxon) based on experience of researchers (123-126), which can be considered in *idea improvement* phase. Based on decisions of the team, H_K listed the steps they should follow in solving question 5 (131-138), which demonstrated the *idea connection* phase.

Assumptions

In this chat segment, the team did clarifications in some issues in which some members had problem or lack of knowledge.

A_B expected to understand if they considered the pre test data in grouped or combined format while applying the normality test. H_K responded that he considered the whole data since they compared three groups together. Next, A_B asked if they performed normality test using all groups data while applying anova. H_K provided confirmation to this question.

Then, A_B asked that if they applied levene test for homogeneity of variance. H_K provided confirmation and indicated that the result shouldn't be significant according to the homogeneity of variance test. Therefore, A_B interpreted that it is not homogenous if one of them is significant. Similarly, H_K indicated the non-homogeneity in the data.

D_C asked the way of interpretation of the p value according to the levene`s test. As a response, A_B stated that all the significance values are more than 0.05, hence all of them satisfy homogeneity test. Other members provided confirmation to such an interpretation.

Line	Date	Post Time	Chat Message
141	12/05/2013	2:57 PM	A_B: i have a question
142	12/05/2013	2:57 PM	A_B: for 2 you said pre is not normally distributed
143	12/05/2013	2:58 PM	A_B: did you group them or take as a whole?
144	12/05/2013	2:58 PM	H_K: yeah
145	12/05/2013	2:58 PM	A_B: for 1,2,3
146	12/05/2013	2:59 PM	H_K: I took them whole
147	12/05/2013	2:59 PM	H_K: since we compare three groups
148	12/05/2013	2:59 PM	H_K: together
149	12/05/2013	3:00 PM	A_B: ok so if we do anova we should make normality test using all groups data
150	12/05/2013	3:01 PM	H_K: right
151	12/05/2013	3:01 PM	A_B: and for homogeneity of variance we use levene's test
152	12/05/2013	3:02 PM	H_K: right in homogeneity of variance test they should be not significant
153	12/05/2013	3:01 PM	A_B: if one of them is significant then it is not homogenous
154	12/05/2013	3:02 PM	H_K: so that we say groups are not homogeneous :)
155	12/05/2013	3:02 PM	D_C: wow so if it is more than 0.05, it is good?
156	12/05/2013	3:02 PM	A_B: yes
157	12/05/2013	3:03 PM	A_B: all of them should be >0.05
158	12/05/2013	3:03 PM	H_K: yes
159	12/05/2013	3:03 PM	A_B: all of the variables
160	12/05/2013	3:03 PM	D_C: to be homogeneous?
161	12/05/2013	3:03 PM	A_B: yes
162	12/05/2013	3:03 PM	D_C: all right
163	12/05/2013	3:03 PM	A_B: great

Analysis of the messages between lines 141 and 163 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. In these messages, members directed questions related to the group's solutions towards questions. Knowledgeable members provided the answers, which demonstrated the *idea generation* phase.

Applying Tests

In this talk, the team applied the statistical tests for the solution of questions 3 and 4.

A_B stated that he experienced confusion about the normality test conducted while applying the t-test or anova. According to his idea, they need to check residual normality in these tests. For H_K, they need to find normality of pretest and posttest scores, which were identified as two dependent variables in the study. D_C and H_K had no idea about the residual, hence asked its meaning. A_B explained that the residual is the difference between two groups.

H_K provided an example about their analysis for clarification. He stated that there are no groups in pretest, and in the post test the students are divided into groups. And then, he offered the paired sample t-test for the post test scores if the normality is satisfied. As stated before, A_B asked if they should consider normality of data or normality of differences for the distribution of pretest and posttest. As a suggestion, H_K indicated to consider just data not the difference.

H_K offered to apply kruskal Wallis in question 3 since the data is not normal according to k-s test. After the suggestion, he applied the test and found the significance value as .909. Therefore, he stated that null hypothesis is not rejected and interpreted the results that there is no difference in groups in pretest. Similarly, D_C interpreted that there is no effect.

Related to normality results of the post test, H_K interpreted that there is no problem and offered to apply one way anova. Other members agreed with this suggestion. The team applied the anova test and interpreted that there is a significant difference between groups means since p equals to 0.015 and smaller than 0.05. As the post hoc test, H_K applied the LSD one and found significant difference between group 1 (X=41,05) and group 2 (X=46,73). Others agreed on these results.

Line	Date	Post Time	Chat Message
363	12/11/2013	3:45 PM	A_B: ok now there is something that is not clear to me
364	12/11/2013	3:45 PM	A_B: in questions the data normality is asked but for t-test or anova i think we need to check residuals normality
365	12/11/2013	3:45 PM	H_K: what is that?
366	12/11/2013	3:46 PM	A_B: that part always confuses me
367	12/11/2013	3:46 PM	H_K: there are two dependent variables in this study
368	12/11/2013	3:46 PM	H_K: pre-test and post-test scores
369	12/11/2013	3:47 PM	H_K: so we need to see only the normality of those scores
370	12/11/2013	3:47 PM	D_C: how about residual normality?
371	12/11/2013	3:47 PM	D_C: when to use it?
372	12/11/2013	3:47 PM	H_K: which variable is residual
373	12/11/2013	3:48 PM	A_B: assume there are 2 groups
374	12/11/2013	3:48 PM	D_C: no I am asking generally
375	12/11/2013	3:48 PM	A_B: take their differences

382	12/11/2013	3:49 PM	H_K: first of all
383	12/11/2013	3:49 PM	H_K: there are no groups at pre-test
384	12/11/2013	3:49 PM	H_K: then we selected students to make a three groups
385	12/11/2013	3:50 PM	A_B: for my question consider q5
386	12/11/2013	3:50 PM	H_K: paired sample t-test
387	12/11/2013	3:50 PM	H_K: if normality satisfies
388	12/11/2013	3:50 PM	A_B: ok
389	12/11/2013	3:51 PM	A_B: the normality of the data or the normality of differences
390	12/11/2013	3:51 PM	H_K: because it is in group
391	12/11/2013	3:51 PM	A_B: ?
392	12/11/2013	3:51 PM	H_K: not between group
393	12/11/2013	3:51 PM	A_B: i mean the distribution of pretest-posttest
394	12/11/2013	3:51 PM	H_K: no forget about differences
395	12/11/2013	3:51 PM	H_K: no need to figure out differences in another variable
396	12/11/2013	3:52 PM	H_K: yes
398	12/11/2013	3:52 PM	H_K: I see that
399	12/11/2013	3:52 PM	H_K: at q1 tab
401	12/11/2013	3:53 PM	H_K: K-S test is significant
402	12/11/2013	3:53 PM	H_K: oops , it leads us to non-parametric tests
403	12/11/2013	3:54 PM	D_C: exactly
404	12/11/2013	3:54 PM	D_C: so a nonparametric test for anova?
407	12/11/2013	3:55 PM	D_C: but we don’t have any groups in pretest
408	12/11/2013	3:55 PM	H_K: Kruskal-wallis
410	12/11/2013	3:55 PM	H_K: Actually we already told about q1 and q2
411	12/11/2013	3:56 PM	H_K: we need to apply Kruskal- Wallis test for q3
412	12/11/2013	3:56 PM	D_C: yeah.
413	12/11/2013	3:56 PM	D_C: shall we do the homogeneity test?
416	12/11/2013	3:57 PM	H_K: no need for now because it is already not normally distributed
417	12/11/2013	3:58 PM	H_K: Now I see Kruskal-Wallis test for pre-test
418	12/11/2013	3:58 PM	H_K: It is not significant
419	12/11/2013	3:58 PM	H_K: Asymmetrical Significance = .909
422	12/11/2013	3:58 PM	D_C: hmm
423	12/11/2013	3:59 PM	H_K: so it is ok
424	12/11/2013	3:59 PM	H_K: null hypothesis is not rejected
427	12/11/2013	3:59 PM	D_C: yeah. we can say that there is no effect
428	12/11/2013	3:59 PM	D_C: right?
429	12/11/2013	3:59 PM	H_K: right
430	12/11/2013	3:59 PM	H_K: it is actually expected
431	12/11/2013	4:00 PM	H_K: because if it was significant differences before the groups
432	12/11/2013	4:00 PM	H_K: research wouldn't be

433	12/11/2013	4:00 PM	H_K: apply those groups
434	12/11/2013	4:00 PM	D_C: yeah sure
435	12/11/2013	4:00 PM	D_C: I think we almost did the 3rd question?
436	12/11/2013	4:00 PM	H_K: so it is ok for research design
437	12/11/2013	4:01 PM	H_K: yes
439	12/11/2013	4:01 PM	H_K: we have no problem the normality of post-test
440	12/11/2013	4:01 PM	H_K: one way ANOVA can be explained
441	12/11/2013	4:01 PM	A_B: ok i got the same results
442	12/11/2013	4:01 PM	D_C: yeah
444	12/11/2013	4:02 PM	D_C: I also got
445	12/11/2013	4:02 PM	H_K: There is a significant difference between groups means
446	12/11/2013	4:02 PM	H_K: at post-test
447	12/11/2013	4:02 PM	H_K: $p<0.05$
448	12/11/2013	4:03 PM	H_K: $p=0.015$
449	12/11/2013	4:03 PM	H_K: According to LSD post-hoc test,
450	12/11/2013	4:03 PM	D_C: yeah
451	12/11/2013	4:03 PM	D_C: and pretest, again we do not have a significance difference
452	12/11/2013	4:04 PM	H_K: there is a significant difference between group 1 (X=41,05) and group 2 (X=46,73)
453	12/11/2013	4:04 PM	A_B: what test did you do?
454	12/11/2013	4:05 PM	H_K: one way ANOVA
455	12/11/2013	4:05 PM	D_C: yeah i got those results
456	12/11/2013	4:05 PM	A_B: ok
457	12/11/2013	4:05 PM	H_K: null hypothesis is rejected
458	12/11/2013	4:06 PM	H_K: now q4 is ok

Based on the Progressive Knowledge Building Inquiry cycle, messages between lines 363 and 458 can be analyzed as follows. There are two different ideas about the normality test. A_B offered to check residual normality (364) and H_K offered to check normality of dependent variables (369), which demonstrated the *idea generation*. D_C asked the meaning of residual normality (370) and A_B explained it as the difference of two groups (373. 375). H_K clarified that there are no groups in pretest (383), and in the post test the students are divided into groups (384). Then, he proposed to employ the paired sample t-test for the post test scores if the normality is satisfied (386, 387), which is considered in *idea connection* phase. Yet, A_B asked again if they should consider normality of data or normality of differences for the distribution of pretest and posttest (389). H_K explained to consider data instead of the difference (390-395), which illustrated the *idea connection* phase.

Between lines 411 and 437, H_K applied the Kruskal wallis test for the solution of 3rd question and interpreted that there is no difference in groups in pretest, which demonstrated the *idea generation* phase. Similarly, D_C interpreted that there is no effect which can be considered in *idea connection* phase.

Between lines 439 and 458, H_K applied the one-way anova test and interpreted the results which illustrated the *idea generation* phase. Other members provided confirmation to the results.

Difference between the Pre and Post test Scores

D_C expected to understand if they would apply anova in question 5. A_B responded that homogenity is satisfied so they could apply anova. H_K provided confirmation to this suggestion.

A_B asked why they preferred LSD as the posthoc test. H_K initially stated that he applied LSD since it was offered by the instructor. Then, he decided to provide more reasoning. He classified the LSD as light, Tukey and Bonferroni as strong tests.

A_B shared the anova results. According to the results, D_C asked if they can say the group1 is the most effective one. On the other hand, H_K explained that anova is not an effect test, and indicated its purpose as checking difference among groups. In addition, he offered to apply regression test to reveal the effects with variance prediction. D_C indicated her understanding of these explanations.

A_B stated that f value is not important in this question. H_K disagreed with this idea for this question, instead offered to interpret f.

Line	Date	Post Time	Chat Message
459	12/11/2013	4:06 PM	D_C: for 5, are we going to do the anova again?
460	12/11/2013	4:06 PM	A_B: levene's test significance is .458
461	12/11/2013	4:06 PM	H_K: no
462	12/11/2013	4:07 PM	A_B: so we can assume homogeneity of variance
463	12/11/2013	4:07 PM	A_B: that’s why we are able to use anova
464	12/11/2013	4:07 PM	H_K: yes
465	12/11/2013	4:07 PM	H_K: right
466	12/11/2013	4:08 PM	A_B: path is more important than destination :)
467	12/11/2013	4:08 PM	H_K: :)
468	12/11/2013	4:08 PM	A_B: because we need to interpret to spread our knowledge from our wiki page
469	12/11/2013	4:09 PM	H_K: ok
470	12/11/2013	4:09 PM	D_C: :)
471	12/11/2013	4:09 PM	H_K: :)
472	12/11/2013	4:10 PM	A_B: why did you use LSD post-hoc option? i missed that part
473	12/11/2013	4:10 PM	H_K: I need to select a post-hoc test
474	12/11/2013	4:11 PM	H_K: I just select LSD because instructor selected in lesson
475	12/11/2013	4:11 PM	H_K: :)
476	12/11/2013	4:11 PM	A_B: ok:)
477	12/11/2013	4:11 PM	H_K: LSD is the lighter one

478	12/11/2013	4:12 PM	A_B: ok can you paste the screenshot and we can discuss about the results very quickly
479	12/11/2013	4:11 PM	H_K: apart from others
480	12/11/2013	4:11 PM	H_K: Tukey is strong
481	12/11/2013	4:12 PM	H_K: Bonferroni is strong either
483	12/11/2013	4:12 PM	A_B: or i can paste quickly if you want
487	12/11/2013	4:14 PM	A_B: ok i pasted it @q4
488	12/11/2013	4:14 PM	A_B: ok same results:)
489	12/11/2013	4:14 PM	A_B: good
490	12/11/2013	4:14 PM	H_K: :)
493	12/11/2013	4:16 PM	D_C: so can we say that 1 is the most effective?
494	12/11/2013	4:16 PM	A_B: ok when you say significant you were inspecting post-hoc table right?
495	12/11/2013	4:16 PM	A_B: for this one
497	12/11/2013	4:17 PM	H_K: which question we are talking
498	12/11/2013	4:17 PM	H_K: q4 ?
499	12/11/2013	4:17 PM	A_B: q4
500	12/11/2013	4:17 PM	H_K: ok , ANOVA is not an effect test
501	12/11/2013	4:18 PM	H_K: it shows us the mean difference between groups
502	12/11/2013	4:18 PM	A_B: and if the difference is significant
503	12/11/2013	4:18 PM	A_B: or not
504	12/11/2013	4:18 PM	H_K: we just say there is a significant difference between groups
505	12/11/2013	4:18 PM	H_K: that’s all
506	12/11/2013	4:19 PM	A_B: ok you decided the significance from multiple comparisons table
507	12/11/2013	4:19 PM	D_C: how about which is the most effective
508	12/11/2013	4:19 PM	D_C: instructor also asks that
509	12/11/2013	4:19 PM	H_K: regression test shows the effects with variance prediction
510	12/11/2013	4:20 PM	H_K: right A_B
511	12/11/2013	4:20 PM	D_C: all right
512	12/11/2013	4:21 PM	A_B: ok F is not important here at all
513	12/11/2013	4:21 PM	H_K: there is an interpret for F
514	12/11/2013	4:21 PM	H_K: but in q4 we don’t need to interpret
515	12/11/2013	4:21 PM	A_B: yes that's my point
516	12/11/2013	4:21 PM	A_B: ok
517	12/11/2013	4:22 PM	A_B: i'm good with q4
518	12/11/2013	4:22 PM	H_K: ok

Analysis of the messages between lines 459 and 518 according to the Progressive Knowledge Building Inquiry cycle results in following interpretations. Initially, D_C asked

if anova is appropriate for the 5th question. A_B offered to perform anova since they assume homogeneity of variance (462, 463), which demonstrated the *idea generation* phase. H_K agreed with this idea (464, 465). A_B asked the reason for selecting LSD as the post hoc test (472). Between lines 473 and 481, H_K provided the reasons of choice and explained the other tests, which can be considered in *idea connection* phase.

According to the anova results, D_C asked if they can interpret that the group1 is the most effective one (493). Between lines 500 and 506, H_K and A_B explained that anova is not an effect test, and stated its goal as checking difference among groups, which illustrated the *idea connection* phase. A_B indicated that f value is not important in the question, which showed the *idea generation* phase. Yet, H_K disagreed and suggested to interpret f, which can be considered in *idea connection* phase.

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PUBLICATIONS

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