# ATTITUDES TOWARDS USING AUGMENTED REALITY IN CORPORATE TRAINING: A CASE STUDY

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# ATTITUDES TOWARDS USING AUGMENTED REALITY IN CORPORATE TRAINING: A CASE STUDY

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DECLARATION OF ORIGINALITY

I, Nilay Güner, certify that

- I am the sole author of this thesis and that I have fully acknowledged and documented in my thesis all sources of ideas and words, including digital resources, which have been produced or published by another person or institution;
- this thesis contains no material that has been submitted or accepted for a degree or diploma in any other educational institution;
- this is a true copy of the thesis approved by my advisor and thesis committee at Boğaziçi University, including final revisions required by them.

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Date 14.05.2018

ABSTRACT

Attitudes Towards Using Augmented Reality

in Corporate Training: A Case Study

In today's rapidly changing world, trainers are required to develop themselves for using technology in their trainings to reach the new generation's needs, and Augmented Reality (AR) is one of the novelties coming with developing technology. Many researches show the benefits of AR usage in education but there are limited studies for corporate trainings. Increasing the use of AR in corporate trainings exactly depends on the development of internal trainers. This study aims to investigate the knowledge level and attitudes of internal trainers about AR usage in education. Based on this purpose, a case study was undertaken with 61 people in a corporate retail company, Turkey. Participants attended to a training session about AR, started with an awareness survey and finished with evaluation survey and interviews. Theoretical model of this study is based on Technology Acceptance Model (TAM). The hypotheses are tested by paired samples t-test, regression, ANOVA and independent samples t-test analysis. The results showed that after two-hours training and application session, almost all participants liked the whole AR experience and found it “beneficial”, “funny”, “engaging”, “interacting”, “creative” and “motivating” for educational use. They have also intended to use AR in their trainings. The other new implications are the suggestions of internal trainers for AR usage examples in different training types and for the development of AR platforms or applications. There are some other findings supporting previous studies. As a result, the future of AR usage in corporate trainings looks bright.

# ÖZET

## Kurumsal Eğitimlerde Artırılmış Gerçeklik Kullanmaya Yönelik Tutumlar: Bir Vaka Çalışması

Teknolojinin hızla değiştiği ve günlük hayatımıza yenilikler kattığı çağımızda, iç eğitmenlerin yeni neslin ihtiyaçlarına uygun hareket etmek için teknolojiye ve yönelimlere hükmedebilmeleri ve eğitimlerinde doğru şekilde uygulayabilmeleri gerekiyor. Arttırılmış Gerçeklik (AG), teknolojinin sunduğu yeni olanaklardan birisidir. Kurumsal eğitimlerde AG kullanımına yönelik sayıca az çalışma bulunmakta ve bunu arttırmanın yolu, iç eğitmenlerin bu konuda yetiştirilmesinden geçmektedir. Bu çalışmanın amacı, iç eğitmenlerin AG ile ilgili bilgi düzeyinin ve AG'yi eğitimlerinde kullanmaya yönelik tutumlarının incelenmesidir. Bu amaçla, bir tekstil-perakende şirketinde, 61 iç eğitmen; ön test ile başlayan, bilgilendirme ve uygulama eğitimi ile devam eden, son test ve görüşmeler ile biten bir vaka çalışmasına katılmışlardır. Teknoloji Kabul Modeli'ne dayanan araştırmada toplanan veriler; bağımlı örneklem t-testi, regresyon, ANOVA ve bağımsız örneklem t-testi ile analiz edilmiştir. Sonuçlara göre, bilgilendirme eğitiminin sonunda; katılımcıların, AG deneyimini sevdiği, eğitimde kullanımı hakkında "faydalı", "eğlenceli", "etkileşimli", "yaratıcı" ve "motive edici" gibi olumlu yorumlarda bulunduğu ve eğitimlerinde kullanmaya yönelik tutum geliştirdiği görülmüştür. Ayrıca, AG'nin farklı eğitimlerde kullanımına yönelik örnekler ile AG uygulamasının gelişmesi gereken teknik özelliklere yönelik önerilerde bulunmuşlardır. Literatürü destekleyen başka sonuçlar da gözlemlenmiş olup, AG'nin kurumsal eğitimlerde kullanımına yönelik olumlu sonuçlara ulaşılmıştır.

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# CHAPTER 1

# INTRODUCTION

Education is a general term for the process of facilitating learning, or the acquisition of knowledge, skills, values, beliefs, and habits, while training is a continuous process from hire to retire to improve critical competencies needed for job performances entirely through so that organizations could reach their targeted outcomes (Aguinis & Kraiger, 2009; Grossman & Salas, 2011).

Teachers or trainers who are the actors of this process transform the content into learning material via the help of technological tools and teaching methods to reach previously defined targets. In the digitizing world, the participant and trainer profiles in the training process have changed, technological tools have been diversified and teaching methods have differentiated. As a result, it is not possible to go on with older methods and habits.

Technology is diffusing rapidly into every field, and education is one of the key areas affected by these innovations. Nowadays, as the life styles of individuals change, trainers need to not only have a good subject matter expertise but also new competencies to be in line with 21$^{st}$ century requirements. In other words; trainers should know their subject matter well, should be good at applying learning principles and theories, as well as should use technology in their trainings. As a result, by increasing the skill of technology usage, following up technological trends and integrating them into their training in a suitable way, trainers can grow up individuals that can adapt and contribute to the information age.

Augmented Reality (AR) is one of the important technological trends started to be used widespread in education. According to Yuen, Yaoyuneyong, and Johnson (2011), “With AR, educators' dream of ubiquitous learning can become a reality”. Through AR, learners could be able to gain immediate access to a wide range of location-specific, enhanced and interactive information. Research shows that the use of AR in education results in numerous advantages for both participants and trainers. In addition, it is seen that AR supports the efficiency of training results. Although there are some studies on K12 teachers' awareness of AR and their desire to use AR; there are not many studies on adult education. For this reason, there is a crucial need for case studies on adult education, particularly for internal trainers in corporate environment.

In a corporate company, internal trainers have a crucial role of training people, spreading corporate information, and increasing skills of these trainers that will help the company to reach more effective and productive results.

This study is carried out to investigate the knowledge level and attitudes of internal trainers about AR usage in education. To be able to achieve this purpose, trainings are organized to increase the knowledge level of participants about AR usage in a corporate retail company, Turkey. At the beginning of the training session, an awareness survey is applied to participants with the purpose of collecting some descriptive data and investigating their prior knowledge about AR. At the end of the training session, an evaluation survey is applied for evaluating the change of the participants' knowledge level about AR and understanding their tendency to use AR in their trainings. After training session was completed, semi-structured interviews were made with some voluntary participants to collect their shining ideas and specific views about AR usage in education.

Methods are applied to the collected data coming from awareness survey and evaluation survey. Open ended questions and interview notes are also included in the study.

The thesis is composed of following chapters: Chapter I is related to the introduction of the study. Chapter II covers the literature review of technology usage in education, corporate training and Augmented Reality. In Chapter III, theoretical model will be proposed. Chapter IV presents the methodology of this study. In Chapter V, the findings and the results of the study will be given. Finally, Chapter VI contains the summary of findings, limitations of the study and suggestions for future research.

# CHAPTER 2

# LITERATURE REVIEW

In this chapter, the literature will be presented under three main parts as follows: Technology in education, technology in corporate learning and augmented reality.

## 2.1 Technology in education

Before focusing on technology usage in education, it is crucial to understand deeply what the learning is, how people learn, how the learning styles are changing. In this part, important studies on learning, adult learning, digitized age, changing lifestyles and transformation in education will be presented.

### 2.1.1 Learning

Changing world has given rise to the appearance of varied lifestyles, work conditions and learning habits. In line with these changes, researchers have been finding out many theories about how human beings learn (Ertmer & Newby, 1993, p.52). In 1996, Shunk started his book with the definition of “Learning involves acquiring and modifying knowledge, skills, strategies, beliefs, attitudes, and behaviors.”

According to chronological order, behaviorists have seen "learning" as a specific change in the observable performance and they put learner in a reactive role in this process. Researchers indicate that learning occurs when learner gives a proper response after the presentation of an environmental stimulus (Ertmer & Newby, 1993, p.55). While environmental conditions receiving the greatest emphasis in behaviorism, knowledge acquisition and mental abilities gain more importance in cognitivism. Cognitivists describe learning as the change on the knowledge level.

Jonassen (1991) pointed out that “learning is concerned not so much with *what* learners *do* but with *what* they know and *how* they come to acquire it” (as cited in Ertmer & Newby, 1993, p.58). In this process, learner has a very active role. After that, constructivists appeared and described learning as interpreting and constructing knowledge from individual’s active experiences and interactions (Bednar, Cunningham, Duffy, & Perry, 1992; Ertmer & Newby, 1993, p.63). Tapscott (1998) introduced the concept that learning has been occurring best by doing. Not surprisingly, it can be easily seen that learners are getting more and more active roles during the learning process than before.

### 2.1.2 Adult learning

Developmental psychologists state that human beings have different physical, mental and psychological needs and skills in different age groups. Piaget (2008) points out that understanding sequential developments of human beings from birth to death is highly important since every stage comes with different needs and responsibilities. People would live up to their full potential only if they can successfully go through these stages. For instance, primary school children can learn in a very different setting from a high school student or an adult. In fact, pedagogy and andragogy are two important disciplines that have been appeared to explain these differences.

According to Malcolm Knowles (1980), pedagogy is “the art and science of teaching children”. The word pedagogy comes from; *peda* meaning “child” and *agogus* meaning “leading”. Therefore, all assumptions of pedagogy are based on teaching children simple skills like reading and writing. On the other hand; Knowles defined andragogy as “the art and science of helping adults learn”.

Adult Learning has appeared after World War II and the first books about Adult Education have begun to be seen during 1950s. After that time, many studies have been done but all the basics could be seen in the research of Knowles known as the origin of adult learning. In the study, andragogy assumptions include that as individuals' mature (Knowles, 1980, p. 44-45):

- their self-concept moves to a self-directed human being
- they have experience that is a highly rich resource for learning
- they have oriented to learn in relation with developmental tasks of their social roles,
- and they need to make applications immediately and thus they have oriented toward performance-centeredness.

Knowles (1980) described the learning assumptions of andragogy as follows:

- Adults can learn.
- Learning is an internal process.
- There are superior conditions of learning which are:
    - The learners feel a need to learn.
    - The learning environment is characterized by physical comfort, mutual trust and respect, mutual helpfulness, freedom of expression, and acceptance of differences.
    - The learners perceive the goals of a learning experience to be their goals.
    - The learners accept a share of the responsibility for planning and operating a learning experience, and therefore have a feeling of commitment toward it.
    - The learners participate actively in the learning process.

- The learning process is related to and makes use of the experience of the learners.
- The learners have a sense of progress toward their goals.

According to Adult Learning Theory, adults come to learning environment with different feelings, viewpoints, needs and purposes, and thus education should be arranged to satisfy all these expectations. To sum up, the world is changing and digitizing faster and faster during the last decades, and it becomes easier to make necessary arrangements with the help of technology-supported opportunities.

### 2.1.3 Digitized age

From the beginning of the history, people have always been discovering new ideas and tools according to their specific needs. With these inventions, technology has developed step by step through agricultural, industrial and information eras (Blinder, 2006). In similar, Plumanns, Sommer, Schuster, Richert, and Jeschke (2016) define the first three industrial revolutions as "the invention of water and steam engine, centralized electric power infrastructure and mass production as well as digital computing and communications technology".

Inevitably, among these revolutions, digital technology is the fastest one affecting human beings in a huge manner. Rohs and Bolten (2017) point out that digital media and technologies have gained an increasingly important role in all areas of society. According to Prensky (2001a, p.2) arrival and rapid dissemination of digital technology in the last decades of the twentieth century have changed many things so fundamentally that "there is absolutely no going back". Researchers point out that digital technology has placed a big role in people's lives and today, world is standing on the verge of a very different era unlike the previous ones.

Plumanns et al. (2016) define the fourth revolution as “Industry 4.0” and they underline that this era will come with some major challenges to almost every part of society.

During the last century, people have gained different features according to the era in which they born and live through. In addition, public attitudes have changed and the gap between the generations have become obvious (Wolf, Carpenter, & Qenani-Petrela, 2005).

Tapscott (1998) defines the ones born between 1946 and 1964 years as baby boomers. Moreover, generation X covers the people born between 1965 and 1976 while generation Y is the ones born between 1977 and 2000 (Wolf et al., 2005). Other researchers divide the ones born after 1980 and call them as the “Net Generation”, “Millennials” or “Digital Natives” (Tapscott, 1998; Prensky 2001a; Nicholas, 2008).

Digital natives are “fluent naturally” with all kinds of information and digital technologies (Thompson, 2013). In addition, they have very different cognitive and social skills than the previous ones in two aspects: First one is based on neurobiology. Prensky (2001a, 2001b) underlines that the brain structure changes with respect to the inputs it receives and thus all the thinking patterns change. Thompson (2013) also clarifies that while the students’ brains are developing, exposition to digital media changes the way of thinking as well as learning. The second one is related with social psychology. Environment and culture where the people are raised influence how they think and behave. In other words, Prensky (2001b) defines that “one’s thinking patterns change depending on one’s experiences” and this results in changing lifestyles and the variety of needs in different parts of life.

### 2.1.4 Changing lifestyles and learning needs

Digital natives who are the first generation growing up with digital devices do not hesitate while using any kind of technology. In fact, their entire lives have been surrounded by the digital age tools such as computer games, e-mail, Internet, cell phones and instant messaging (Prensky, 2001a). Thompson (2013) specifies that "digital native generation is universally proficient on all digital technology tools". However, not surprisingly, Mat-jizat, Jaafar, and Yahaya (2017) point out that nowadays new generations mostly prefer smartphones more than computers.

Close relationship with digital technology make digital natives earn a new lifestyle surrounded with different abilities, preferences, and attitudes while shopping, working, learning, etc. (Thompson, 2013). The learners have changed radically in a very short period of time but the education systems have continued with older methods. Prensky (2001a) defines that "Today's students are no longer the people our educational system was designed to teach". Looking from educational aspect, digital natives and the later generations do not feel comfortable if they do not see the technology in the classroom. Reigeluth specifies that:

> One of the few things that practically everyone agrees on in both education and training is that people learn at different rates and have different learning needs. Yet our schools and training programs typically teach a predetermined, fixed amount of content in a set amount of time. (2016, p.1)

Prensky (2001b) agree that digital natives have some new skills of 21$^{st}$ age and unfortunately, traditional teacher or trainers easily ignore this crucial need. New learners cry out for their learning desires.

Mat-jizat et al. (2017), give the details of learning preferences of new comers as follows:

- Doing is more important than knowing or memorization of facts (knowledge),
- A need for immediacy,
- Not dictating a solution, rather than, solving problems with trial and error approach,
- Low boredom threshold,
- Multitasking and parallel processing,
- Visual, non-linear and virtual learning
- Collaborative learning, and
- Constructivist approach

In summary, digital natives prefer visual communications as well as adaptive, interactive and social environments. According to International Education Advisory Board (2008), they like to be in control and they tend to take more risk than previous ones (as cited in Mat-jizat et al., 2017). In addition, they can feel bored easily since they have short attention span and lack concentration. Trainers or educators feel something is going wrong but they continue to give instruction as they do in the past. Previous studies agree that if educators do not adopt their instruction to new learners' needs then they will fail to reach learning objectives. All educators should urgently respond today's learners differing needs (Prensky, 2001b, p.6; Tapscott, 2008, p. 368; Rosen, 2010; Thompson, 2012, p.12).

### 2.1.5 Transformation in education

According to previous studies of Tapscott (1998) and Reigeluth (2016), there have been some new shifts in training systems covering these essential characteristics:

- Learner-centered vs. teacher-centered instruction
- Learning by doing and discovering vs. teacher presenting
- Learning how to learn vs. just absorbing material
- Lifelong learning vs. school learning
- Facilitating trainer vs. transmitter trainer
- Attainment-based vs. time-based progress
- Customized vs. standardized instruction
- Criterion-referenced vs. norm-referenced testing
- Collaborative vs. individual
- Enjoyable vs. unpleasant

Using technology in education is a good solution to reach these characteristics. At the same time, according to the study of McKnight et al. (2016); there are some advantages of technology usage in education:

- Technology improves access to all resources at anytime and anywhere
- Technology enhances communication and feedback between learners, trainers and other third parties
- Technology restructures trainers time
- Technology extends purpose and open new perspectives for learners
- Technology shifts teacher and student roles

Due to the changing lifestyles and the different needs of the new generation, the use of technology in education has become inevitable. So, to provide this vision for these new comers, there should be a big transformation in education. It is necessary to design systems with strategic thinking, to follow and invest in new trends, and to develop well qualified trainers or teachers.

## 2.2 Technology in corporate training

In this part, the workplace learning will be discussed in terms of the role of internal trainers and technology usage in corporate trainings.

### 2.2.1 Lifelong learning in workplace

World has been changing tremendously during the last centuries and business world has been adopting to the transformation processes because of these changes. Organizations that aim to sustain their present success in future are making a big effort to analyze past and present change elements and to make a difference in their vision. With this point of view, they make huge investment into technology, develop their employees by spreading lifelong learning culture, and prefer to work with such people. After industrial revolution, during a long time, the people who work like machines were needed, while today's expectations differ from the history since digitalization and globalization reshape the requirements of global labor market (OECD, 2012, p.26). Today's employees should be powerful in understanding, thinking, developing, adding value, and being innovative (Arguinis & Kraiger, 2009; Gibson, 2016). Companies know that they should work with such employees to gain competitive advantage and reach their target.

Plumanns et al. (2016) underline the high effects of ongoing digitalization for today's occupations in such a way that "some occupations will be ceased, others will change, and new ones will occur." As a result, people will trach down the new occupations which will be popular in the next decade. Moreover, they are aware of the increasing number of new competencies arising from new occupations day after day. Consequently, willingness to adopt these changing conditions, standards and trends coming from digitalization is the most crucial skill to have the power of competition while building a successful future for millennium workers. So, lifelong learning is gaining more and more importance for workers besides organizations at these days (Gibson, 2016; Kincheloe, 1995).

Lifelong learning is as a self-motivated process to get required knowledge for especially for adults' continuous development. Gibson (2016) defines lifelong learning as "the practice of consciously choosing to improve rather than decline, and to move forward rather than fall behind." As lifelong learning has gained popularity, the companies increase the training and development activities more and more.

According to Goldstein and Ford (2002), "training" refers to a systematic approach to learning and improving individual, team, and organizational effectiveness (as cited in Aguinis & Kraiger, 2009). A specific learning goal which is mostly based on a job performance problem is accomplished by training while creating permanent cognitive and behavioral changes.

In organizations, while poorly trained workers make more mistakes and cause extreme costs, well prepared trainings improve motivation, commitment, good relationships, work quality and productivity of workers (Arthur, Bennett, Edens, & Bell, 2003; Grossman & Salas, 2011).

At the same time, a good designed training is a powerful tool that brings about a highly important competitive advantage to the corporations. Consequently, companies make highly increasing investments in learning and development activities day by day.

The Association for Talent Development (ATD) which is a professional membership organization supporting those who develop the knowledge and skills of employees in organizations around the world published the 2016 State of the Industry Report (SIR, 2016). According to this report:

- Annually $1,252 is reserved for the training and development of each employee.
- Each employee has taken 33.5 hours of training in their organizations in 2015.

Hester, Hutchins, and Burke-Smalley (2016) summarize that development of knowledge, skill, and ability is going to continue to be a prioritized issue for workplace.

### 2.2.2 Internal trainers

Corporate trainings are separated into many subgroups according to the competencies (behavioral development, leadership development, and occupational or technical development) which will be aimed to be developed after the training sessions. The role of the instructor is mainly undertaken by outsourced firms especially in behavioral and leadership trainings. On the other hand, occupational or technical trainings are mostly given by internal trainers due to a few reasons; (1) institutions do not want to share their technical or professional information with outsource firms, (2) big budgets are needed for outsourced trainings,

(3) internal trainers have such a permanent and vast corporate memory that anyone else cannot have apart from the organization (Gibson, 2016). Consequently, trainings with internal trainers provide speed, cost advantages and information security to the institution. For this reason, companies generally invest on their internal trainers to be equipped with necessary skills.

Gibson (2016) introduces internal trainers who are the expert of their subject matters and have the years of experience as well as huge industry expertise. Therefore, Subject Matter Experts (SMEs) have some strengths contributing to their trainings as follows (Gibson, 2016, p.45):

- a detailed knowledge for the training in the direction with job skills
- a rich personal experience to support training with real-life examples and field applications
- a small amount of time needed to prepare the course content,
- an automatic credibility for the participants
- industry expertise which is hard to reach for outsourced trainers

Besides strengths, there are some weaknesses related with SME trainings. As SMEs do not have any expertise on how adults learn, they generally tend to transfer a vast amount of knowledge to the participants even more than the desired level. So, this big amount of transfer leads to the confusion and information overload for participants. Such trainings could not satisfy training needs completely and thus the training goals and purposes could not be reachable. To prevent from such results; efficient, understandable, and relevant learning experiences should be designed in workplace learning activities with the help of adult learning principles which are as follows (Gibson, 2016, p.45):

- Autonomy: Adults need to have control of their learning activities and resist to the situations in which they are imposed to do something.
- Experience: Adults come to learning environment with their own experiences and they need to make connections with these previously owned ones.
- Motivation: Adults like to learn how useful the training will be and if they are satisfied about training need, they enter learning environment with a big internal motivation.
- Relevance: Adults should be provided relevant information with their training need.
- Application: Adults need to apply the information immediately during or after the training.

### 2.2.3 Technology usage in corporate training

Learning and Development (L&D) departments in corporate organizations aim to professionalize their internal trainers with Train the Trainers' Program in order that SMEs start to learn adult learning principles and apply to their trainings. This is a good solution for developing andragogy skills, but this is only one part of professionalization of adult trainers in today's and future's world. Due to digitized age, trainers also need to learn and develop their technological skills. Therefore, SMEs and all internal trainers should follow technology, learn new coming trends and apply them into their trainings in order to be in line with digital era requirements. Otherwise, Giannoukos, Hioctour, Galiropoulos, and Besas (2017) give warning that they are "at risk of digital exclusion". In summary, digitalization brings new opportunities as well as challenges for SMEs and internal trainers like all adult educators.

L&D departments and organizations should create supportive strategies and environment for SMEs and internal trainers to follow and evaluate new technologies in terms of their usefulness for supporting teaching/learning processes (Rohs & Bolten, 2017). Plumanns et al. (2016) give an example for new trends that a large market arises in the field of augmented and virtual learning environments with the advent of Industry 4.0. To understand whether this trend improves users' learning outcomes; the trainers need be involved in such projects, develop ideas about the usage in trainings and practice to see how beneficial the results are.

According to the new report published by ATD Research (2016) with the name of "Virtual Classrooms Now: Using Technology to Reach Today's Workforces", about two-thirds (64 percent) of organizations experience virtual classrooms for employee learning. Moreover, another 22 percent define that they are not using virtual classrooms now, however, they plan to experience within two years' time.

As can be seen from these recent studies, most companies are aware of the importance of following and applying technological trends into all areas that affect their business results, and hence they take crucial actions to get benefits into their all processes.

## 2.3 Augmented reality

Nowadays, one of the important technological trends started to be used widespread in education is Augmented Reality (AR), which is used to add virtual objects into real environments. With recent advances in mobile technologies, AR has become more and more popular.

Especially, the fast-developing features of mobile devices (mobile platforms - iOS and Android, built-in cameras, GPS sensors, and Internet access) allow AR to be reachable by broad public today and seems to get more emphasis in the near future (Azuma, 1997; Yuen et al., 2011; Sommerauer & Muller, 2014; Uluyol & Eryılmaz, 2014).

### 2.3.1 Investigating AR from past to future

#### 2.3.1.1 The sword of Democles

Although AR seems as a new coming trend, in fact, it has a history of nearly a half-century. The beginning of Augmented Reality was based on Sutherland's work in 1968 which used an optical see-through head mounted display (HMD) to present 3D graphics. The HMD was named as "The Sword of Damocles" which was mounted on the ceiling of the room. Sutherland explained the purpose of the research as follows:

> The fundamental idea behind the three-dimensional display is to present the user with a perspective image which changes as he moves. The retinal image of the real objects which we see is, after all, only two-dimensional. Thus if we can place suitable two-dimensional images on the observer's retinas, we can create the illusion that he is seeing a three-dimensional object. (1968, p.757)

Because of the limited capacity of the computers, only very simple wireframe drawings could be displayed. However, the study was accepted as the base of augmented and virtual reality (Azuma et al., 2001; Lee, 2012).

Only three decades after, at the beginning of 1990s, Tom Caudell, a former Boeing researcher, was first coined the term "Augmented Reality" to describe the process of augmenting the real world by virtual data.

In 1992, Caudell and Mizell used an HMD for assisting maintenance and repairing tasks in the aircraft industry and that was a good example for a wide variety of fields in the industry (Lee, 2012; Bacca, Baldiris, Fabregat, & Graf, 2015; Diegmann, Schmidt-Kraepelin, Van den Eynden, & Basten, 2015).

At these times, AR had been accepted as a form of virtual reality and it had been thought that AR could only be usable with an HMD. However, with evolving technologies, it was realized that AR was a concept rather than a technology and AR could take place with more hardware and software options.

As a result, in the 1990s, AR started to take the attention of researchers as an interesting topic (Wu, Lee, Chang, & Liang, 2013).

#### 2.3.1.2 A reality-virtuality continuum

In 1994, Milgram and Kishino developed a continuum to describe and differentiate the concepts of reality, virtuality and mixed reality so that the same terminology would be used by the later researchers in their studies and theoretical discussions.

According to the study of Milgram and Kishino (1994), the different combinations are illustrated in Figure 1, from a completely real environment to a completely virtual one. While real environment (known as Reality) was shown at one side of the continuum, virtual environment (known as Virtual Reality) was at the opposite side. Real Environment includes completely real objects which essentially exist within that world without the necessity of any device to see, touch or experience. However, Virtual Environment is composed of solely virtual objects which are digitally synthesized and produced by the computers to give the feeling of "it was real". A more complicated one is mixed reality (MR) that comprises of both real and virtual objects at the same time within a single display.

Consequently, mixed reality took place between two sides of the continuum and could be divided in two parts according to the level of virtuality or reality of the environment: Augmented Virtuality (AV) and Augmented Reality.

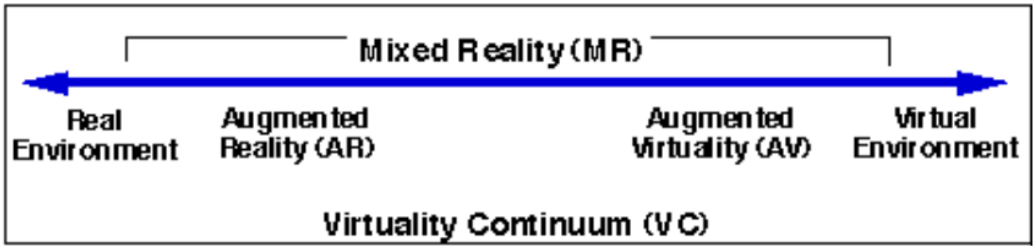


Fig. 1 Simplified representation of a "virtuality continuum" (Milgram & Kishino, 1994, p.3)

Reality is a familiar concept for everyone since it is about the things that can be seen, heard, touched and get experienced in some way. However, Mixed Reality (MR) refers to the condition that brings real world elements and virtual elements together. The process of using real-world objects as a background and enhancing them with digitally synthesized elements is called Augmented Reality. On the other hand, adding the real elements into surrounding virtual environment is known as Augmented Virtuality. In summary, this differentiation between AR and AV is directly based on whether reality or virtuality is being enhanced and on the weight of the augmentation. In other words, the more the level of augmentation increases, the closer the environment to the Virtual Reality is (Milgram & Kishino, 1994; Azuma et al., 2001; Pan, Cheok, Yang, Zhu, & Shi, 2006).

Virtual Reality is an interactive, immersive and imaginative environment. In VR, participants experience 3D representation of the real-world, navigate in abstract environments, look from different perspectives to specific events and perform dangerous tasks in safe conditions (Milgram & Kishino, 1994; Burdea & Coiffet, 2003; Huang, Rauch, & Liaw, 2010; Wojciechowski & Cellary, 2013; Ke, Lee, & Xu, 2016, p. 212).

#### 2.3.1.3 Increasing attention toward AR

After the research of Milgram and Kishino (1994) added important concepts to the literature, in 1997, Azuma published a study with the name of "A Survey of Augmented Reality". In this study, the researcher described the developments and problems related with AR.

One of the important points is that Azuma (1997) avoided to limit AR to specific technologies, and defined AR as a system with three important characteristics:

- combining real and virtual objects in a real environment,
- running interactively in real time, and
- aligning real and virtual objects with each other to reach 3D preview (Azuma et al., 2001; Sommerauer & Muller, 2014).

Azuma (1997) pointed out a different usage of AR that as well as overlaying virtual objects in the real environment, it was also possible to hide or remove some objects in the perceived environment (Azuma et al., 2001).

After Azuma's study, in the late 1990s, AR's growth and progress became remarkable as a research field. In the following years, several conferences and workshops started to be focused in this area such as International Workshop and Symposium on Augmented Reality, the International Symposium on Mixed Reality, and the Designing Augmented Reality Environments workshop. Moreover, some organizations were established like Mixed Reality Systems Lab in Japan and the Arvika consortium in Germany. Parallel to the rising popularity, in the field, the number of developers started to increase. As a result, first AR toolkit was developed (Azuma et al., 2001; Phan & Choo, 2010).

Since 2000s, technological wave has been accelerating, and the processing power of personal computers and mobile devices have been rising more and more. These rapid speeds of devices and widespread usage of Internet provided AR applications to improve and differentiate (Dede, 2008; Yuen et al., 2011). Many companies started to invest in this field and online AR development tools like Aurasma, Layar, Wikitude, Blippar, etc. appeared to make AR development easy for public users. As a result, day by day, AR used projects has been proliferated.

Azuma is one of the first people to study about Augmented Reality and he is known as the father of this field. In 1997, in his study, he predicted that "Within another 25 years, we should be able to wear a pair of AR glasses outdoors to see and interact with photorealistic dinosaurs eating a tree in our backyard". Supporting the estimation of Azuma, researchers and futurists predict that AR will be an inseparable part of everyday life soon. Some industry experts especially from maintenance and repairing fields have been using AR to import benefits into their business. In addition, nowadays, audio-visual media, e-commerce, travel, marketing and education are the other fields trying to get use of AR technology (Yuen et al., 2011; Uluyol & Eryılmaz, 2014; Bacca et al., 2015).

#### 2.3.1.4 From today to future

Nowadays, an increasing number of researchers and some famous research companies have been showing a big interest towards investigating what would be possible in AR/VR field in near future. Deloitte University Press, a global research center of Deloitte Company, has published the Technology Trends Report (Deloitte TTR, 2018) and specified that "Augmented reality and virtual reality revolution has reached a tipping point".

Pokemon Go, a popular location-based AR game, earned a surprising popularity all over the world after it had released in July 2016. What Pokemon Go accomplished is that the game reached a record-setting number of users as soon as it was introduced to public. Today, there are still a huge number of Pokemon Go gamers around the world. The purpose of the game is to walk around the streets, parks and other locations to find out Pokemons. With the help of a handheld device, people see Pokemon in their actual environment. Therefore, the mechanic of the game is simply based on the characteristics of location-based AR applications.

Juniper Research, founded in 2001, is one of the leading analyst firms in the mobile and digital technology sector, identifying and appraising new high growth market sectors within the digital ecosystem. Juniper Research (JR, 2017) estimated approximately 500 million total downloads for Pokemon Go at the end of 2016 while this number was 17 million for the total of other AR Games. Pokemon Go has become a popular issue around the world and this situation shows the companies aiming to make investments into AR field that this is only the beginning of AR technology and the society is ready for more.

Deloitte University Press emphasized that it is crucial to support AR/VR technologies and other tech trends together to evolve in Tech Trends 2017 report (Deloitte TTR, 2017). For instance, IoT, internet of things makes the objects connected to each other, and in such an environment, taking the signals as an input from these connected objects provides a more interactive AR experience for users. Therefore, in the near future, all technology trends will come together and be usable in a nested way. The report underlines some investment companies in Silicon Valley to think about the ways of reaching this vision.

Gartner, known as the world's leading research and advisory company with unique combinations of trusted insights, strategic advices and practical solutions has released "Top 10 Strategic Technology Trends for 2017" at the end of the last year (Gartner, 2017). Three important themes which were intelligence, digital, and mesh have formed this report, and "Virtual & Augmented Reality" was in the 4th place, under the digital theme. The company defined virtual reality (VR) and augmented reality (AR) as the way of transforming people's interaction with each other and with software systems by providing an immersive environment. The report predicted that "Over time AR and VR expand beyond visual immersion to include all human senses. Enterprises should look for targeted applications of VR and AR through 2020."

According to the estimation of JR (2017), the AR market will be expected to grow from $515 million in 2016 to $5.7 billion in 2021. In addition, "Worldwide Semiannual Augmented and Virtual Reality Spending Guide" has been prepared by International Data Corporation (IDC), a global provider of technology markets with expertise on technology trends in over 110 countries from 1964. The study shows that AR/VR market will increase from $9.1 billion in 2017 to approximately $160 billion in 2021 with an annual growth rate of 113.2 percent.

Figure 2 shows what the market share will be for different device and platform types. In short term, handheld devices will bring more income and HMDs are only in prototyping phase whereas in long term HMDs will be more commonly used in society (Deloitte TTR, 2018).

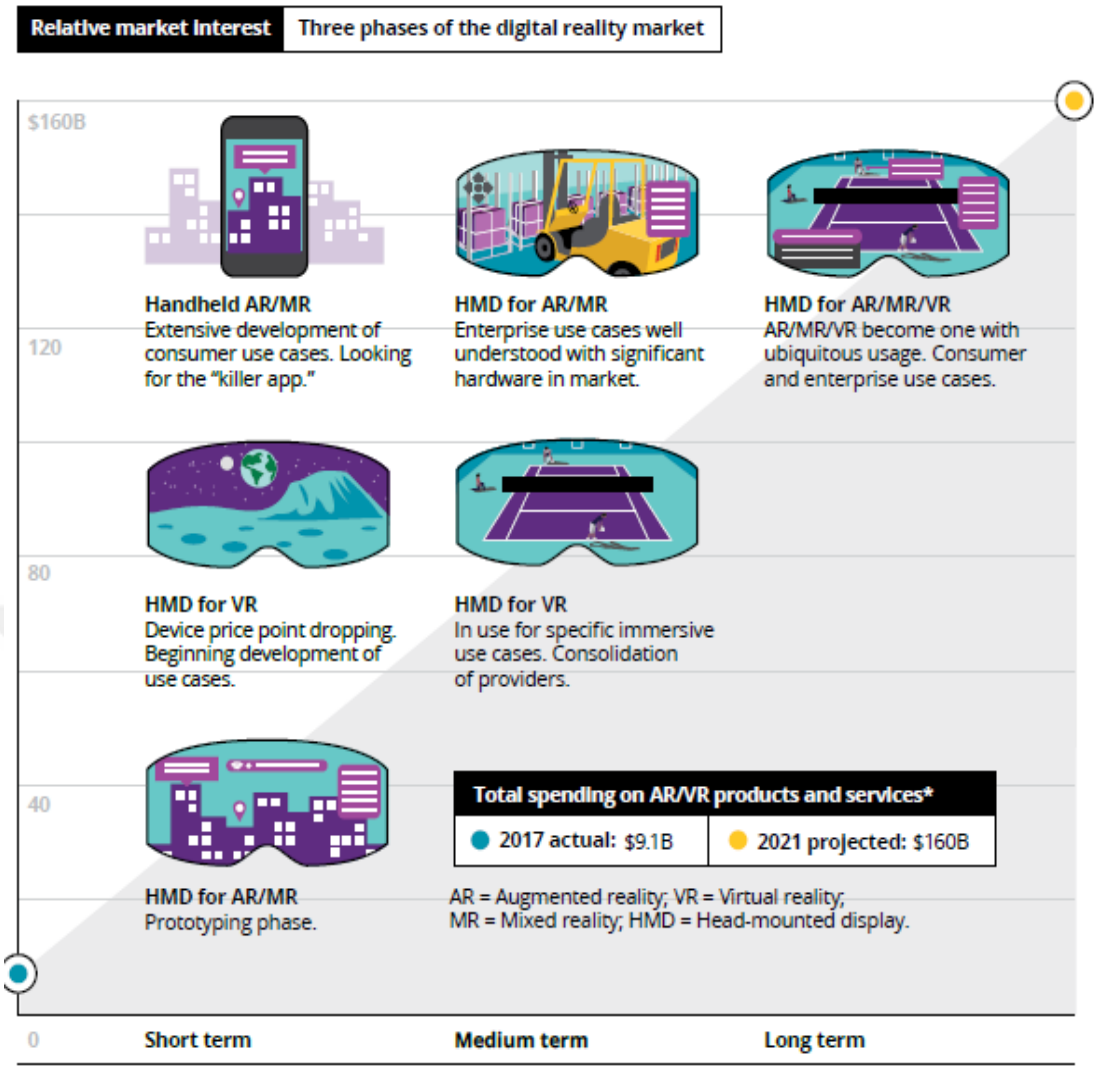


Fig. 2 Digital reality in the marketplace (Deloitte TTR, 2018, p.78)

Supporting this result, during the last decade, most companies have developed AR focused strategies and moved towards AR/VR to invest in this visionary field. During 2017, as was estimated, the leading technology companies like Apple, Google, Facebook, etc. have made important attacks:

- Apple introduced ARKit (2017) which is a framework that provides an easy way to public people to create an augmented reality experience on iOS devices without a developer need.

- After a short time, like Apple's attempt, Google has presented ARCore (2017) which is a platform for building augmented reality applications on Android devices. Looking from backward, Google has made too many attempts such as Google Glass, Tango, Cardboard, has learnt many lessons from these steps and has been designing strategies feed for future.
- Following these, Mark Zuckerberg, known as an internet entrepreneur and co-founder of Facebook, made his comments during Facebook's annual F8 developer conference (Facebook F8, 2017) in San Jose. He emphasized that Facebook team has been working on incorporating AR on smartphones regardless of the type of device or mobile platform. AR has gained attention of these important companies during 2017.

Another futuristic evidence is "Top 10 Strategic Technology Trends for 2018" which was introduced by David Cearley, vice president of Gartner Fellow, at Gartner 2017 Symposium/ITxpo in Orlando, Florida (Gartner, 2018). He said that "Technology will be embedded in everything in the digital business of the future." As same as the previous report, AR and VR technologies have taken 7$^{th}$ place with the name of "Immersive Experience" under digital theme. The report (Gartner, 2018) predicted that in the following next five years Mixed Reality would be in the foreground. After Apple's ARKit and Google's ARCore attempts, it would be possible to wait the battles for smartphone-based AR and MR in 2018.

Concluding all developments, investments and predictions, AR is a well-known technology, but it is still at its infancy. As Lee defined (2012) "The future of AR as a visualization technology looks bright". Consequently, as a promising technology, AR will be gaining more and more importance soon.

### 2.3.2 AR definition

Since 1990s, there has been an increasing number of studies focusing on augmented reality field. As a result, definitions of AR have become to be varied with respect to different aspects as follows:

- Adding virtuality into reality
    - Augmented Reality is quite appropriate for describing the essence of computer graphic enhancement of video images of real scenes (Milgram & Kishino, 1994)
    - AR allows the user to see the real world, with virtual objects superimposed upon or composited with the real world (Azuma, 1997).
    - An AR system supplements the real world with virtual (computer-generated) objects that appear to coexist in the same space as the real world (Azuma et al., 2001).
    - The ability to overlay computer graphics onto the real world is commonly called Augmented Reality (Billinghurst, 2002).
    - AR allows digital content to be seamlessly overlaid and mixed into our perceptions of the real world (Yuen et al., 2011).
    - Augmented reality is an emerging form of experience in which the real world is enhanced by computer-generated content which is tied to specific locations and/or activities (Yuen et al., 2011).
    - AR lets users perceive the real world, along with 'added' data, as a single, seamless environment (Yuen et al., 2011).
    - AR exploits the affordances of the real world by providing additional and contextual information that augments learners' experience of reality (Wu et al., 2013).

    - In AR, virtual information is presented on the real environment as if it coexists with real objects (Santos, Taketomi, Yamamoto, Rodrigo, Sandor, Kato, 2015).
- As a bridge between reality and virtuality
    - AR can be thought of as the "middle ground" between VE (completely synthetic) and telepresence (completely real) (Milgram, Takemura, Utsumi, & Kishino, 1994).
    - AR bridges the gap between the real and the virtual in a seamless way (Chang, Morreale, & Medicherla, 2010, as cited in Lee, 2012).
- Removing real object from real environment
    - Current work has focused on adding virtual objects to a real environment. However, graphic overlays might also be used to remove or hide parts of the real environment from a user (Azuma, 1997).
    - Certain AR applications also require removing real objects from the perceived environment, in addition to adding virtual objects. For example, an AR visualization of a building that stood at a certain location might remove the building that exists there today (Azuma et al., 2001).
- Effect for senses
    - AR can potentially apply to all senses, including hearing, touch, and smell (Azuma et al., 2001).

- As a technology
    - Augmented reality refers to a wide spectrum of technologies that project computer generated materials, such as text, images, and video, onto users' perceptions of the real world (Yuen et al., 2011).
    - AR could be created by utilizing and connecting various innovative technologies (e.g., mobile devices, wearable computers, and immersion technologies) (Wu et al., 2013).
    - Augmented reality applications are complex technological experiences, delivering learning content through a medium different from non-AR experiences (Radu, 2014).
    - Augmented reality refers to technologies that dynamically blend real-world environments and context-based digital information (Sommerauer & Muller, 2014).
    - Augmented reality is an emerging technology that utilizes mobile, context-aware devices (e.g., smartphones, tablets) that enable participants to interact with digital information embedded within the physical environment (Dunleavy, 2014).
- As a variation of MR
    - AR is a variation of MR since it uses virtual objects to add into real scene (Milgram et al., 1994).
    - Augmented reality is a variation of virtual environments, or virtual reality as it is more commonly called (Azuma, 1997).
    - AR is quite similar to virtual reality. Both are interactive, immersive, and include information sensitivity (Yuen et al., 2011).

### 2.3.3 AR types

Some studies classify augmented reality according to the device or technology used while the others group related to the trigger element that starts the AR engagement.

#### 2.3.3.1 Device-based AR types

Since 1960s, augmented reality content has been viewed via several devices. Radu (2014) summarized AR experiences depending on the devices used in three groups:

- Head-Mounted-Display AR
- Webcam-based AR and
- Smartphone-based AR

Head-mounted-display (HMD) AR was the first example usage of AR experiences. In this type, people had to wear specialized glasses to get inside the augmented world. Additionally, users could see both real and the digitalized world on the screen of HMD (Yuen et al., 2011). In these early times, unsurprisingly, it was hard to feel impressed while wearing glasses. Hopefully, recently, technology companies will make investments in this field and device. As a result, many new glasses have been developed and used by people following this technology. Consequently, as Plumanns et al. (2016, p.395) defined, new versions like Oculus Rift provides "sensations of immersion, flow, and spatial presence."

Webcam-based AR application has been used more through in the early 2000s. This AR type lets users to experience Augmented Reality through a computer. It starts with getting a real environment as a background by the computer camera, continues with adding digital layout and objects, and finalizes with showing the augmented experience on computer screen or a projector (Radu, 2014).

Smartphone-based AR applications are the ones which are used widespread nowadays. Users may see the digitalized world through the smartphone camera. The mobility of the devices provides people move through their environment during the experience of Augmented Reality and gives a feeling of flexibility to the user. As a result, the faster handheld devices and mobile platforms develop, the more AR users would increase (Yuen et al., 2011; Radu, 2014).

To sum up, Smartphone-based AR applications are more widely used but HMD is also a preferred type with respect to the older version. Soon, it would not be a surprise that HMDs will be evolved and some new devices which are completely different from previous ones appear since AR is still a developing technology.

#### 2.3.3.2 Trigger element-based AR types

Some researchers have grouped AR applications according to the trigger element that starts the experience (Yuen et al., 2011; Dunleavy & Dede, 2014; Mat-jizat et al., 2017). In the literature, it is possible to see differing names, but an Augmented Reality content can be triggered mainly in two ways:

- Location based AR
- Marker based AR

Location based AR is used on GPS-enabled smartphones equipped with GPS technology, an accelerometer, and a digital compass (magnetometer) (Yuen et al., 2011). GPS signals take the location information from the environment and start the AR interaction according to this data (Dunleavy & Dede, 2014; Mat-jizat et al., 2017). This type best fits into the situations that people need to get a 3D augmented information about where they are. Field experiments or trips and adventure games could be examples for the usage areas of Location based AR applications.

Marker based AR is another type in which people should place the camera of their mobile devices to a triggering object for starting the AR engagement (Yuen et al., 2011; Dunleavy & Dede, 2014). In this type, marker could be a 2D QR Code as well as a 3D marker image according to the used AR platform. After the smartphone camera perceives the marker image, 3D animations and digital information come into real environment. Additionally, as people move the smartphone camera on the marker image, 3D enhanced content changes as well.

Consequently, Location based AR and Marker based AR are two developing aspects of augmented reality experiences. Although they are classified as two different types in the literature, it would be better to accept that they could be used together for reaching more immersive interactions.

### 2.3.4 AR features

Researchers have defined some similarities and common features between AR and VR (Dunleavy et al., 2009).

According to Milgram et al. (1994), AR is a variation of MR since it uses virtual objects to add into real scene. In addition, Yuen et al. (2011) points out the similarity between AR and VR in terms of immersion, interactivity and information sensitivity. Similarly, Fonseca, Marti, Redondo, Navarro, and Sanchez (2014) underlines the common features as follows: immersion, navigation, and interaction.

Burdea and Coiffet (2003) defined immersion, interaction and imagination as the properties of VR. Moreover, Pan et al. (2006) accepted both VR and MR as a technological breakthrough and underlined that they owned immersive, interactive and imaginational advantages. Based on these properties, another research was conducted by Huang et al. (2010). This study investigated the relationships between

these features of VR, and one of the important findings was about the similarity between AR and VR in terms of defined properties. As a result, in this part, Augmented Reality will be detailed in terms of the following features: immersion, interaction and imagination.

#### 2.3.4.1 Immersion

Milgram et al. (1994) defined immersion as "virtual and real environments can each be displayed without the need for the observer to be completely immersed within them". Furthermore, Ke et al. (2016) has compiled two different definitions. First one is "the subjective impression that one is participating in a comprehensive, realistic experience". Second one is "the semi-voluntary experience of being transported into an alternate context for an extended duration".

Another research done by Sherman and Craig (2003) has classified immersion in two parts: physical immersion and mental immersion. Physical immersion is related with movements and actions inside the virtual scene whereas mental immersion is more about the "state of being deeply engaged" in a VR environment (Huang et al., 2010).

Deloitte TTR (2018) underlines that "Immersive technology is the next computing platform, after mobile". According to the report, over the next few years, immersive technology will be inseparable part of our daily life. Many researchers have been dealing with advantages of these technologies in very different areas. For instance, Dunleavy et al. (2009) pointed out that immersion technology could provide usefulness and change people's preferences in so many different areas, such as learning styles (Fonseca et al., 2014).

Huang et al. (2010) defined that with immersive technologies, people experience more than the one which has totally happened in classroom. As a result, learners feel inside of the issue, cognitively more engaged and have the chance of getting more knowledge and skill in such situations. In their study, Huang et al. (2010) summarized the positive sides of using immersive VR technologies in traditional classroom as follows: motivation, deep learning and active learning.

#### 2.3.4.2 Interaction

Steuer (1992, p. 14) investigated the prior studies about the term interactivity and summarized the ones related with VR environment. One important point in the study is the definition of interactivity: “the extent to which users can participate in modifying the form and content of a mediated environment in real time”. The study includes the factors affecting interactivity as follows (Steuer, 1992):

> …speed, which refers to the rate at which input can be assimilated into the mediated environment; range, which refers to the number of possibilities for action at any given time; and mapping, which refers to the ability of a system to map its controls to changes in the mediated environment in a natural and predictable manner. (p. 15)

Looking from learning aspect, interactivity means that learners are actively engaged in learning process by putting theoretical concepts into daily life exercises and applications. This is called experiential learning which best could be happening in teaching labs. However, traditional learning system has some restrictions to increase the number of experiential learning classes due to the need for expensive equipment, safety measures, and trained people (Wojciechowski & Cellary, 2013).

VR or MR technologies could overwhelm these restrictions easily. A VR system could perceive users’ gestures as input and give a reaction to these actions simultaneously while users could follow these reactions in a screen.

In addition, users could also have the chance of experiencing all the results of their actions by touching, hearing, seeing smelling and tasting just like in real life (Huang et al., 2010).

According to Moore (1989), there are three types of interactions which are critical in VR environments: learner-to-learner, learner-to-content interactions and learner-to-instructor. Learners need to communicate between each other to share ideas. Learners also want to interact with the content to construct their understanding easily. In addition to these, as like in classroom, learners require to be in touch with the instructor for motivation and also getting feedback about their situation (as cited in Huang et al., 2010). Some other studies also defined that interaction characteristics of VR and MR technologies make it easier for people to deeply understand a new knowledge with the help of realistic-looking environments, 3D models, multimodal feedbacks, and avatar of trainers (Huang et al., 2010; Fonseca et al., 2014; Radu, 2014, p.1534; Santos et al., 2015).

#### 2.3.4.3 Imagination

Imagination is another significant property of immersive environments. Huang et al. (2010) specified that imagination is the ability of helping people to perceive abstract or nonexistent things. Stapleton, Hughes, Moshell, Micikevicius, & Altman (2002) have defined imagination as the skill of completing a story's missing parts in a creative way.

In VR or AR environments, there are some important skills like creativity, critical thinking, and problem-solving which have a strong connection with imagination capability. 3D visualization of immersive technologies and interactivity options create an imaginative atmosphere.

This supernatural effect of the environment let people think more creative, use more critical thinking skills, follow more invisible cues and find easier solutions to their problems. Consequently, using VR or AR technology, these skills get better and contribute to increase in imagination capability (Huang et al., 2010).

### 2.3.5 AR usage in different areas

It could be easily seen that best practices in Augmented Reality field have well designed characteristics in terms of immersion, interaction, and imagination. In other words, when an AR application is designed by satisfying these features, it will possibly be a well-known example like PokemonGo game. There are also some other fields implementing AR in their contexts and get advantages of the technology such as advertisement-marketing, architecture and construction, entertainment, medicine, military, travel, and training (Azuma, 1997; Yuen et al., 2011; Mat-jizat et al., 2017).

- Advertisement-marketing field uses to get attention of customers.
- Architecture and construction field uses to visualize a virtual construction project in 3D models to provide easy understanding for designers, workers, and customers.
- Entertainment area uses virtual singers and hologram show performances to present audiences more engaging experiences.
- Medicine is an important area implementing new technologies quickly and easily. With AR usage, medical surgeries and clinical operations could be simulated in a more cost effective and safer environment.

- Military is another significant and prior field getting advantages of technology trends. A well-known example usage of AR in this field could be aircraft simulations.
- Travel field highly utilizes the GPS-supported functions of AR. For instance, while reaching a destination point, holographic signs or markers can appear in a virtual map. Another important usage is the one that tourists can learn additional information about historically or culturally important places.
- Training is a special field using AR in many different settings.

Nowadays, AR seems to be an expensive technology and thus, the limited number of examples could be seen. However, in the near future, the benefits will get more emphasis and numerous ways will occur to develop AR projects (Yuen et al., 2011). To sum up, as researchers and futurists define, AR systems will be used in many areas more than today.

### 2.3.6 AR usage in education

AR is an exciting concept that has started to be used widespread in education since this innovative technology could make trainers' dream of personalized, deep, and active learning come into real (Yuen et al., 2011). However, while applying a trend into any part of daily life, it is necessary to see both positive and negative sides, define important points, and plan carefully. Similarly, AR has important advantages as well as some crucial discussion points when using in education.

#### 2.3.6.1 Advantages of AR usage in education

AR creates magical experiences by using new technologies. However, this value of AR experience is not only about the technology, but also related with its designation, integration, and implementation (Wu et al., 2013).

The number of previous researches has investigated the benefits of AR usage on education from early childhood to adult training. As expected, the results have introduced that AR could be a powerful tool to use in education and could provide many advantages from different perspectives (Billinghurst, 2002; Shelton & Hedley, 2002; Klopfer & Squire, 2008; Yuen et al., 2011; Lee, 2012; Wu et al., 2013; Dunleavy & Dede, 2014; Radu, 2014; Uluyol & Eryılmaz, 2014; Santos et al., 2015).

For instance, some studies have covered technological advantages while some others have included learning or teaching advantages. However, Diegmann et al. (2015) have conducted a detailed literature review to investigate a set of 25 publications. As a result, researchers have defined 14 benefits under six different groups as in the first column of Table 1. Although this is a good contribution, there are still several advantages that might be added to these groups. The second column of Table 1 shows the extended version of the ones coming from Diegmann et al. (2015).

Table 1. List of Augmented Reality Advantages

| Original Grouping | | Extended Grouping | |
|---|---|---|---|
| Main Topic | Sub Topic | Main Topic | Sub Topic |
| State of Mind | Motivation | State of Mind | Motivation |
| | Attention | | Attention |
| | Concentration | | Concentration |
| | Satisfaction | | Satisfaction |
| Teaching concepts | Student-centered learning | Teaching concepts | Student-centered learning |
| | Collaborative learning | | Collaborative learning |
| | ---- | | Contextual learning |
| | ---- | | Problem-based Learning |
| Presentation | Details | Presentation | Details |
| | Accessibility Information | | Accessibility information |
| | Interactivity | | Interactivity |
| Learning type | Learning curve | Learning type | Learning curve |
| | Creativity | | Creativity |
| Content understanding | Spatial abilities | Content understanding | Spatial abilities |
| | Memory | | Memory |
| | --- | | Achievement level |
| Reduced costs | --- | Reduced costs | --- |
| --- | --- | Safety | --- |
| --- | --- | Efficiency and Effectiveness | --- |

The extended version of AR advantages is as follows (Diegmann et al., 2015):

1) State of the Mind

   a) Increased motivation: AR has a special feature that makes students more interested, engaged, and motivated while learning a content (Yuen et al., 2011; Lee, 2012; Radu, 2014; Mat-jizat, Jaafar, & Yahaya, 2017).

b) Increased attention: Engaged and motivated students could direct their attention to learning activities in longer durations (Radu, 2004; Wojciechowski & Cellary, 2013).

c) Increased concentration: With the help of interactive AR experience, students could deeply focus and highly concentrate into learning concepts for longer durations.

d) Increased satisfaction: Because of high enthusiasm and fun, students are quite satisfied during AR supported learning experience (Radu, 2014).

2) Teaching concepts

a) Increased student-centered learning: Diegmann et al. (2015) has defined student-centered learning as "a teaching concept in which conventional lectures are replaced by new active and self-paced learning programs". AR supports learning-by-doing environment in which students take both the responsibility and control of their own learning process and behave in correspondence to their own capability. Trainers help them by acting as a facilitator (Yuen et al., 2011; Lee, 2012; Wojciechowski & Cellary, 2013; Mat-jizat, Jaafar, & Yahaya, 2017).

b) Improved collaborative learning: AR increases collaborative learning by creating possibilities for more communication and cooperation among students as well as between students and teacher. With the help of these relationships, it would be easier to transfer knowledge (Billinghurst, 2002; Radu, 2004; Yuen et al. 2011; Wojciechowski & Cellary, 2013).

c) Contextual/situated learning: AR experiences occur in real environments with the addition of rich and valuable virtual content. As a result, students have the chance of learning an ability or information in its actual context, and they can apply these knowledge and skills in their real environments (Lee, 2012; Wojciechowski & Cellary, 2013). This makes learning more meaningful and concrete.

d) Problem-based learning: AR gives the chance of looking to an issue or a concept from different perspectives and this is a critical skill needed for solving problems. Trainers as a facilitator introduce a problem to learners in an AR experience and learners try to solve the issue by discovering different ways. (Huang, Rauch, & Liaw, 2010)

3) Presentation

a) Increased details: Comparing to traditional learning environment, AR could give the opportunity of reaching more detailed information with respect to students' own learning capability.

b) Increased information accessibility: AR supported learning environments have better opportunities to make easier access to learning content and related information.

c) Increased interactivity: Diegmann et al. (2015) defined increased interactivity as "a precondition for other presented benefits". Similarly, Mat-jizat, Jaafar, & Yahaya (2017) underlined that "AR can provide a unique and interactive experiences to students". As a result, the transfer of learning is maximized much more than before with the interaction of learners with 3D content, learning tool, and teacher. (Radu, 2004; Lee, 2012).

4) Learning type

   a) Improved learning curve: Delello (2014) pointed out that AR would be a powerful tool to overcome learning disabilities or of barriers by differentiating learning to the type of learners. In other words, AR provides learning environment with different tools for different learning styles (Yuen et al., 2011). As a result, students learn easier and faster than before.

   b) Increased creativity: AR promotes creative learning environments for learners to discover new knowledge and skills from different ways. As a result, learners can find innovative solutions to the problems in their learning environment (Huang, Rauch, & Liaw, 2010; Yuen et al., 2011; Mat-jizat, Jaafar, & Yahaya, 2017).

5) Content understanding

   a) Improved development of spatial abilities: With the help of AR, learning content could be presented to the learners in a meaningful and concrete way that is not possible with traditional teaching methods (Radu, 2004). Spatial contexts might be one of the best usage areas of this novel way in learning since it is hard “to gain real-world first-hand experience” in these fields, and it is beneficial to make “learning-by-doing” type of activities (Yuen et al., 2011). As a result, AR improves learning of spatial concepts such as architectural structures, geometrical shapes, chemical structures, mechanical machinery, astronomy configurations, or spatial configuration of human organs. In other words, AR could make it easier to understand abstract issues that are not possible to see by naked eye (Klopfer &

Squire, 2008; Wojciechowski & Cellary, 2013; Fonseca et al., 2014; Mat-jizat, Jaafar, & Yahaya, 2017).

b) Improved memory: Many studies show that AR improves knowledge retention, provides better short and long-term memory results (Radu, 2014; Mat-jizat, Jaafar, & Yahaya, 2017).

c) Achievement level: With the help of improved memory and the other benefits, the students reach better achievement levels in AR environment than traditional one.

6) Reduced costs: Although establishing the AR technology has high acquisition cost, it is easy to see that "this investment is most likely to pay off in the long term" (Diegmann et al., 2015). Moreover, AR learning environments could provide cost reduction during experiments by transforming usage of real supplies with virtual ones (Wojciechowski & Cellary, 2013).

7) Safety: AR learning environments have the chance of practicing dangerous activities and experiments with virtual objects under safe conditions. This will protect unskilled learners from unexpected incidents (Lee, 2012; Wojciechowski & Cellary, 2013; Plumanns et al., 2016)

8) Efficiency and effectiveness: In an AR supported learning environment, learners could get necessary information and practice important skills at the right time and the right place. In other words, AR could make all educational activities to have more productive, efficient and effective results (Lee, 2012).

Owing to these important advantages, AR seems to be an important part of educational environments in the near future (Lee, 2012; Wu et al., 2013).

#### 2.3.6.2 Discussion points of AR usage in education

The future of AR looks brilliant. However, after deciding to use AR in education, there are some crucial points and barriers to consider until the implementation step (Wu et al., 2013):

- Institution aspect: As like previous technology integration examples, institutions have some constraints related with time and financial sources. They may see AR implementation in education as time-consuming, expensive and unnecessary. Although AR brings cost reduction in the long term, institutions may not accept to pay high costs at the beginning of the process (Lee, 2012; Wojciechowski & Cellary, 2013; Wu et al., 2013).
- Trainer aspect: Many trainers follow technological trends, learn how to use, and implement them into their life and trainings with their intrinsic motivation. On the other hand, some others, especially the older ones, resist learning about any novelty. They produce many excuses since these trends bring the necessity of learning new teaching styles as well as using new technologies. (Lee, 2012; Wojciechowski & Cellary, 2013; Wu et al., 2013)
- Instructional design aspect: Instructional design field produces the following questions:
    - Who is the target audience? Are there any differences between the learners in terms of the targeted content and the technology skills?
    - What are the goals and objectives?
    - What is the content?
    - Which training methods and techniques are going to be used?
    - How is the training session going to be managed and assessed?

Unless these main questions are answered and planned according to the principles and theories coming from instructional design field, every one of them could transform into strong barriers while using AR in trainings (Radu, 2014).

- Content and technology support aspect: The implementation of hardware/software is an important step, and mostly corporations or educational institutions overcome this problem by buying AR supported learning packages including both hardware/software and some limited content. However, after beginning to use these packages, some devices could be broken, some software needs to be updated, and some content needs editing or new production requests start to increase. If all these previously was not foreseen, it is possible to see some negative consequences (Lee, 2012; Wu et al., 2013).
- Usability aspect: Usability of the software has a crucial role. Azuma et al. (2001) underlined that user interface limitations directly affect how learner's feel and think. A usable screen with good design and planned learning content can make learners to be motivated and satisfied. Owing to these feelings of learners, trainers get the intention and habit of using AR in education again and again. On the other hand, when the usability of the screens is limited, learners may not have fun and unfortunately, trainers may not reach training purposes at the aimed level. As a result, trainers may decide to refuse using this new experience during their training sessions (Radu, 2014).

- Learning aspect:
    - Attention-tunneling: AR brings interactivity and excitement to learning environment, and this novelty may lead to ignore the main topic while giving attention to more simple parts. Radu (2004) called this challenge as "attention-tunneling". To avoid this effect, learners should be directed towards the target in the most accurate way.
    - Cognitive load: Radu (2004) summarized Mayer's multimedia learning theory as "the human brain has limited capacity for processing information from sensory channels (thus, too much information results in cognitive overload and is detrimental to learning)". In an AR supported training, learners try to both accomplish lesson tasks or activities and use new technology or device at the same time. Unless learners are not supported with enough scaffolding and guidance, this multitasking process may affect them to feel overwhelmed or cognitively loaded (Dunleavy, Dede, & Mitchell, 2009; Wu et al., 2013).
    - Lack of skills: AR supported trainings have more constructive structure. That is, learners should use more complex skills like problem-solving, critical thinking or collaborative approaches. If students lack these cognitive skills, it is hard for them to adopt this new style of learning. Consequently, donation of learners with this necessary new thinking skills is another challenge for learning (Klopfer & Squire, 2008; Wu et al., 2013).

If all these discussion points are considered seriously and all these restrictions can be eliminated, AR usage in education is going to provide efficient and effective learning results.

#### 2.3.6.3 AR usage examples

Researchers have studied many examples of AR usage with training purposes from a variety of fields and disciplines, some of which are as follows (Kaufmann, Schmalstieg, & Wagner, 2000; Fjeld, Juchli, & Voegtli, 2003; Klopfer, & Squire, 2008; Dunleavy et al., 2009; Yuen et al., 2011; Lee, 2012; Di Serio, Ibanez, & Kloos, 2013; Wojciechowski & Cellary, 2013; Santos et al., 2015):

- To learn vocabulary in language learning,
- To feel inside the previous historical events and learn about the culture,
- To get inspired in visual arts,
- To simulate surgical operations in medical training,
- To visualize 3D models in architecture and engineering,
- To understand the relationships between the earth, the sun and the other planets in astronomy,
- To imagine how an atom or a molecule moves and bonds each other in chemistry,
- To investigate the structure of human body in biology,
- To understand in a concrete way all shapes and their three-dimensional constructions in mathematics and geometry,
- To observe various principles and theories in physics.

Studies have shown that AR-based technologies are applicable for teaching and learning purposes in natural science, medicine, engineering, languages, history, and other subject areas. Like different fields, AR could also be implemented in different learning environments such as kindergartens, schools, universities, corporate trainings, laboratories, museums, parks, and even zoos (Dunleavy & Dede, 2014; Wu et al., 2013; Sommerauer & Muller, 2014).

#### 2.3.6.4 AR usage in corporate training

Pioneer companies have been following the technological waves and try to embed all novelties into their daily routines and according to these developments, revise their most of the processes. Similarly, AR takes more place in companies' agenda day-by-day. They especially integrate AR into their production cycles and trainings of both employees and their customers.

As looking from a customer's perspective, an important example is from Automaker Audi that the company has prepared a virtual room to inform customers about the vehicles' inner features, model configurations and some usage tips (Deloitte TTR, 2018).

Another perspective is the employee training. In corporate training, there can be numerous examples but the most common one is usage of AR in safety trainings. Occupational Safety and Health (OSH) trainings are crucially important and informing the employee under safe conditions is very hard in real environments. With the help of AR technology, OSH trainings could be simulated without taking any incident risks. (Lee, 2012) In addition, employees could easily learn company's production cycles or core processes via drill and practice environment of AR technology. For instance, KFC implements a funny way of learning with mixed reality. The company places the employees in a virtual "escape room" and employees should finish "a five-step chicken preparation process" to get out of this room (Deloitte TTR, 2018).

As a result, the more the leading companies look towards AR, the more the creative examples of AR usage in corporate trainings will arise. Owing to efficient, effective and productive results, the number of AR supported workplace learning examples will increase in the near future.

# CHAPTER 3

# THEORETICAL MODEL

## 3.1 Technology acceptance model

In 1975, Fishbein and Ajzen introduced a leading theory which was known as "Theory of Reasoned Action". After that Ajzen (1991) underlined that "explaining human behavior in all its complexity is a difficult task" (p.179) and presented an extension of this previous model with the name of "The theory of planned behavior" (p.181). In 1989, Davis developed Technology Acceptance Model based on the main principles from Fishbein and Ajzen's study to understand why people accept or reject certain information technologies (Davis, 1989; Davis, 1993, p.476; Davis & Venkatesh, 1996, p. 20). TAM has become a fundamental research model in the literature for learning about new technology acceptance (Ibanez, Di Serio, Villaran, & Delgado-Kloos, 2016).

The basic TAM model was comprised of perceived usefulness, perceived ease of use and attitude toward usage, all of which affect actual system use. Davis (1985, p.26) defined perceived usefulness as "the degree to which an individual believes that using a particular system would enhance his or her job performance". Moreover, Davis (1985, p. 26) described perceived ease of use as "the degree to which an individual believes that using a particular system would be free of physical and mental effort". According to Ajzen (1991, p.188), attitude toward usage can be explained as "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question".

According to TAM which can be seen in Fig. 3, actual system use is affected from attitude towards usage. Moreover, attitude towards using a system is influenced by both perceived usefulness and perceive ease of use. In addition, perceived ease of use has effect on perceive usefulness. Apart from these relationships, some external variables such as system characteristics, development process or training may impact perceived usefulness and perceived ease of use.

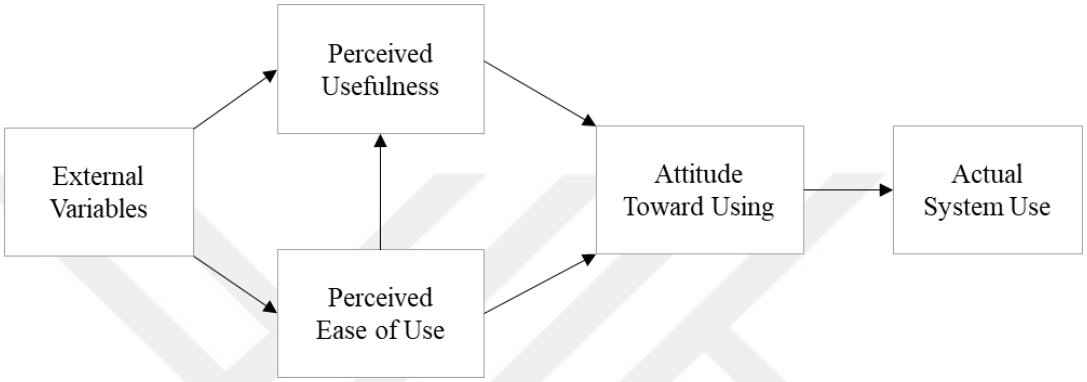


Fig. 3 Technology acceptance model - TAM (Davis, 1985, p.24)

TAM was extended and introduced as Technology Acceptance Model 2 (TAM2) by Davis and Venkatesh (2000). TAM2 includes new determinants affecting perceived usefulness: subjective norm, image, job relevance, output quality, result demonstrability. Furthermore, TAM2 has two moderating variables: experience and voluntariness. TAM2 can be seen in Fig.4.

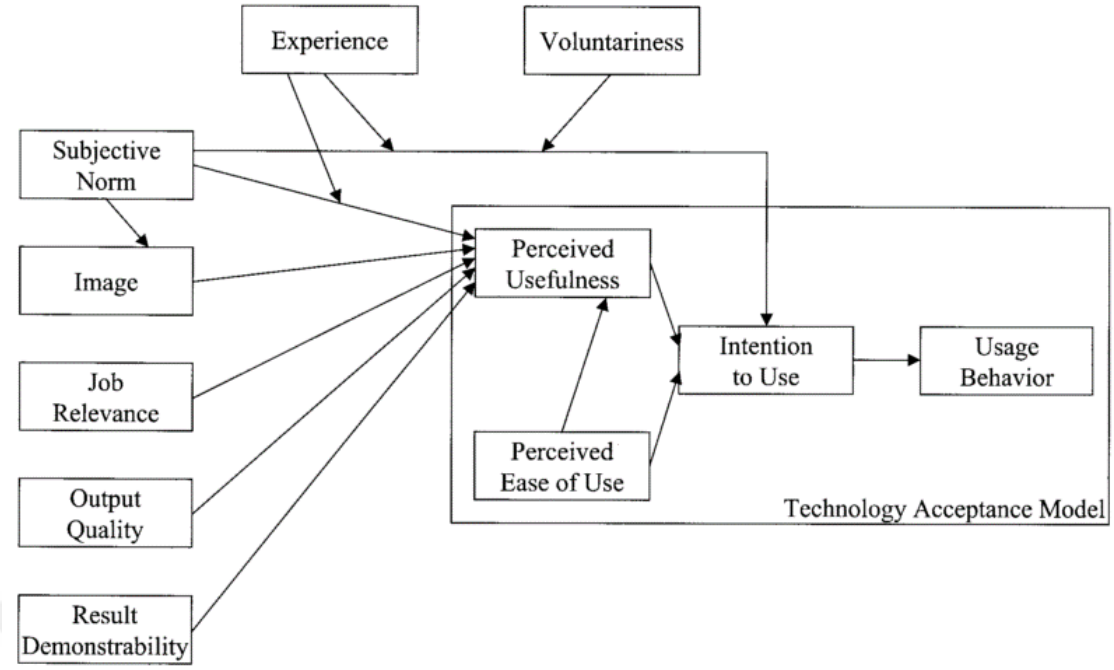


Fig. 4 Technology acceptance model 2 - TAM2 (Venkatesh & Davis, 2000, p.188)

In Fig. 5, Venkatesh (2000) defined six determinants of perceived ease of use as follows: computer self-efficacy, perception of external control, computer anxiety, computer playfulness, perceived enjoyment and objective usability.

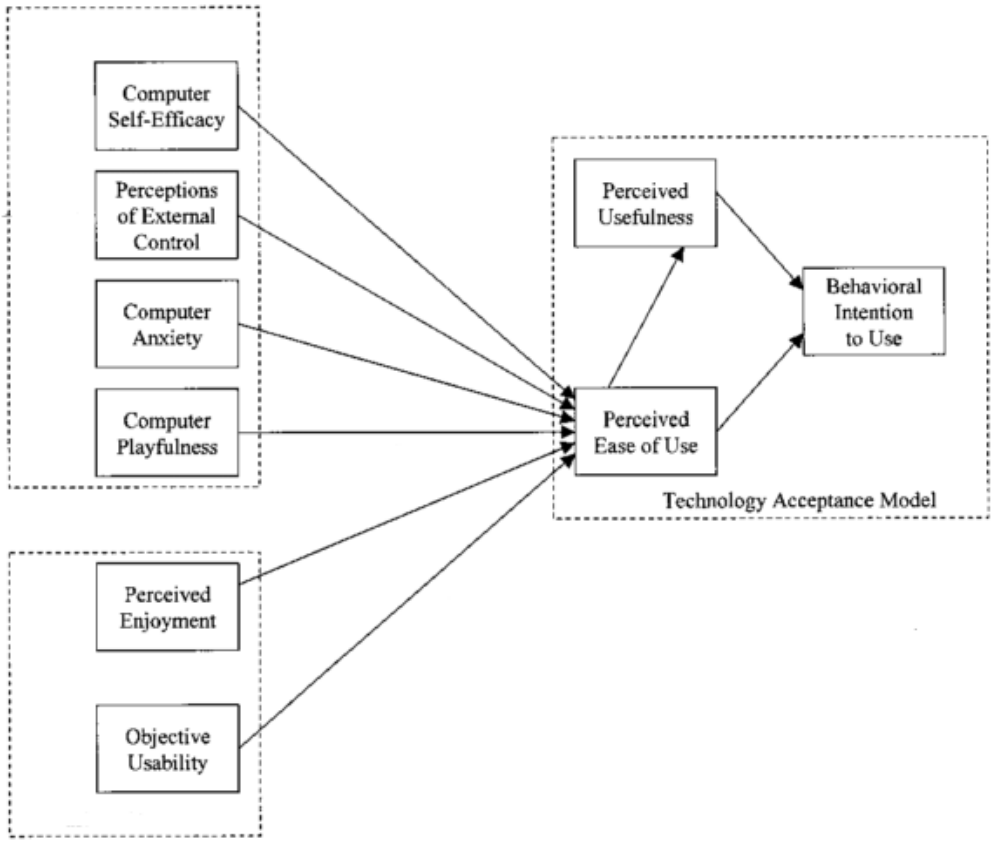


Fig. 5 TAM2 with determinants of perceived ease of use (Venkatesh, 2000, p.346)

Venkatesh and Bala (2008) integrated the seven determinants (result demonstrability, output quality, job relevance, image, subjective norm, experience and voluntariness) with TAM2 and they developed Technology Acceptance Model 3 (TAM3) which can be examined in Fig. 6.

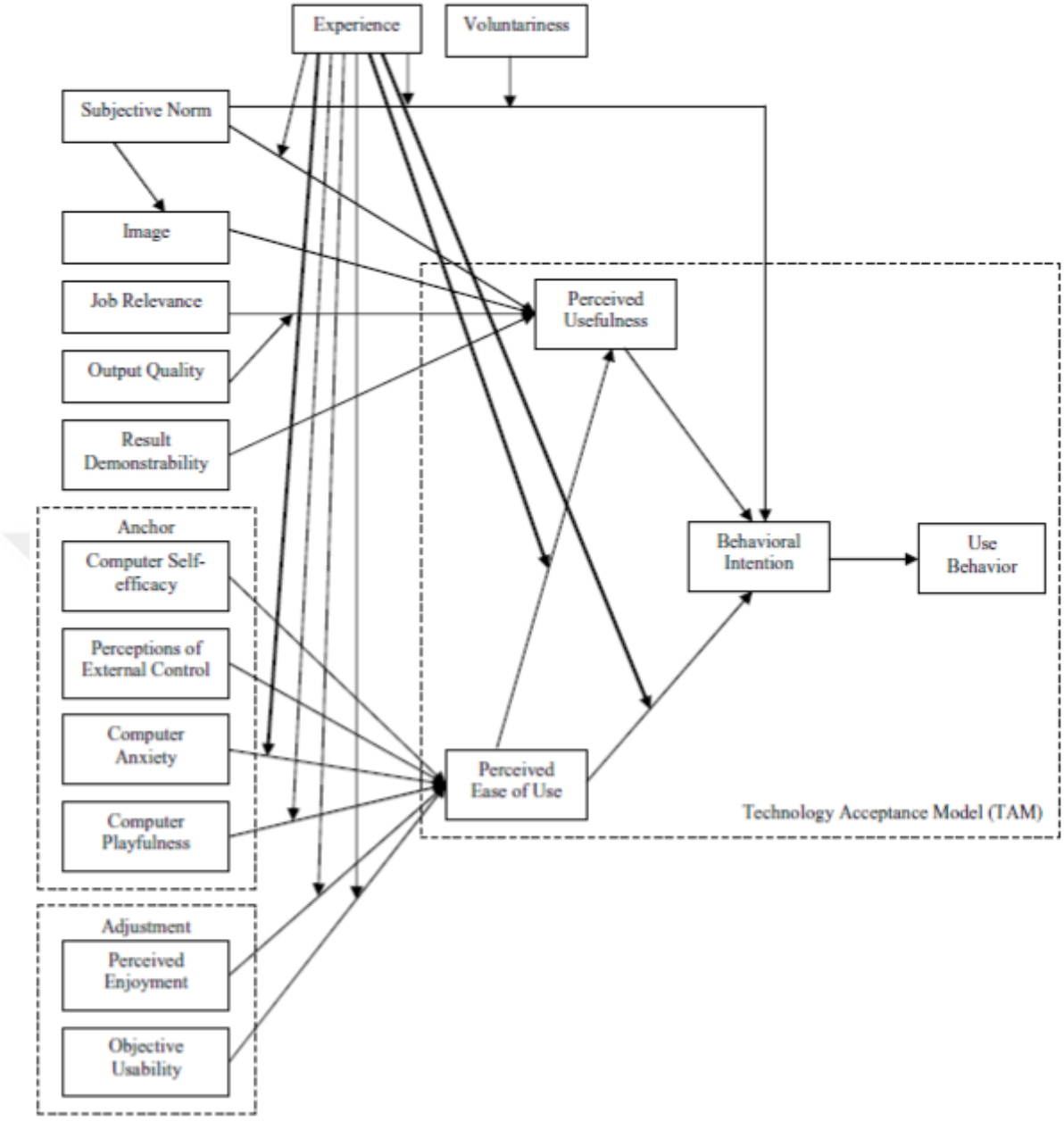


Fig. 6 Technology acceptance model 3 - TAM3 (Venkatesh & Bala, 2008)

As AR is a promising research area and TAM is a fundamental model in the literature, AR related studies has become to use Technology Acceptance Model for understanding whether users accept or reject AR technology. Ibanez et al. (2016) have investigated the attitude of undergraduate engineering students toward AR learning activity using perceived enjoyment.

Results show that perceived ease of use positively affected students' perceived usefulness and perceived enjoyment. In addition, perceived enjoyment and attitude toward usage had a positive effect on intention to use AR learning activity.

## 3.2 Theoretical model

The purpose of this thesis is to investigate the knowledge level and attitudes of internal trainers about AR usage in education. As mentioned earlier, TAM is a fundamental research model in the literature for learning about new technology acceptance. To reach given purpose, depending on TAM's basic principles, it has been aimed to propose a new theoretical model to investigate intention to use AR.

Perceived usefulness, perceived ease of use and attitude towards usage are the main determinants affecting intention to use a new technology. All these aspects are taken from TAM, but the crucial issue is to define the variables related with these aspects. At this point, the prior studies about AR usage in education were investigated.

As given previously, perceived usefulness was defined earlier as "the degree to which an individual believes that using a particular system would enhance his or her job performance" (Davis, 1985, p.26). According to the literature, perceived usefulness could be investigated in two aspects: AR features and AR advantages.

- Previous studies show that AR is a variation of MR with the following features: immersion, interaction and imagination features (Milgram et al., 1994; Burdea and Coiffet, 2003; Pan et al., 2006; Huang et al., 2010; Yuen et al., 2011; Fonseca et al., 2014). If an AR environment is designed with regard to these features, many advantages could be seen.

- Furthermore, another study (Huang et al., 2010) shows that all these advantages could enhance the AR users' performance. In conclusion, perceived usefulness aspect covers AR features and AR advantages, and AR features affects AR advantages.

As defined in TAM, perceived usefulness affects AR attitude. Based on this relationship, AR advantages could affect AR attitude. In addition, as an emerging technology, AR has a novelty effect on users and AR advantages might influence intention to use AR directly.

As mentioned earlier, Davis (1985, p.26) defined perceived ease of use as “the degree to which an individual believes that using a particular system would be free of physical and mental effort". According to the literature, perceived ease of use has been investigated in two aspects: application usability (ApUs) and material/content usability (MCU).

- The more the content is presented, the harder to use an AR system is. In addition, the structure of the given information also has crucial importance. So, the amount and structure of knowledge presented by the AR system affects users’ perception of how easy to use the system (Santos et al., 2015).
- The less the participants meets with user interface and application usage errors, the easier to use the AR application or the system is (Santos et al., 2015). So, the applications or systems having good user interfaces and effective navigation elements without perceptual and ergonomic errors are perceived as ease to use.

As defined in TAM, perceived ease of use affects AR attitude. Based on this relationship, application usability (ApUs) and material/content usability (MCU) could affect AR attitude.

Attitude towards usage has been defined earlier as “the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question” (Ajzen, 1991, p.188). As defined in TAM, attitude towards usage AR affects intention to use AR.

In conclusion, theoretical model of this study includes AR features, AR advantages, material/content usability, application usability and AR attitude as independent variables and they influence the dependent variable which is intention to use AR. The theoretical model given in Fig. 7 shows the relationships among the variables.

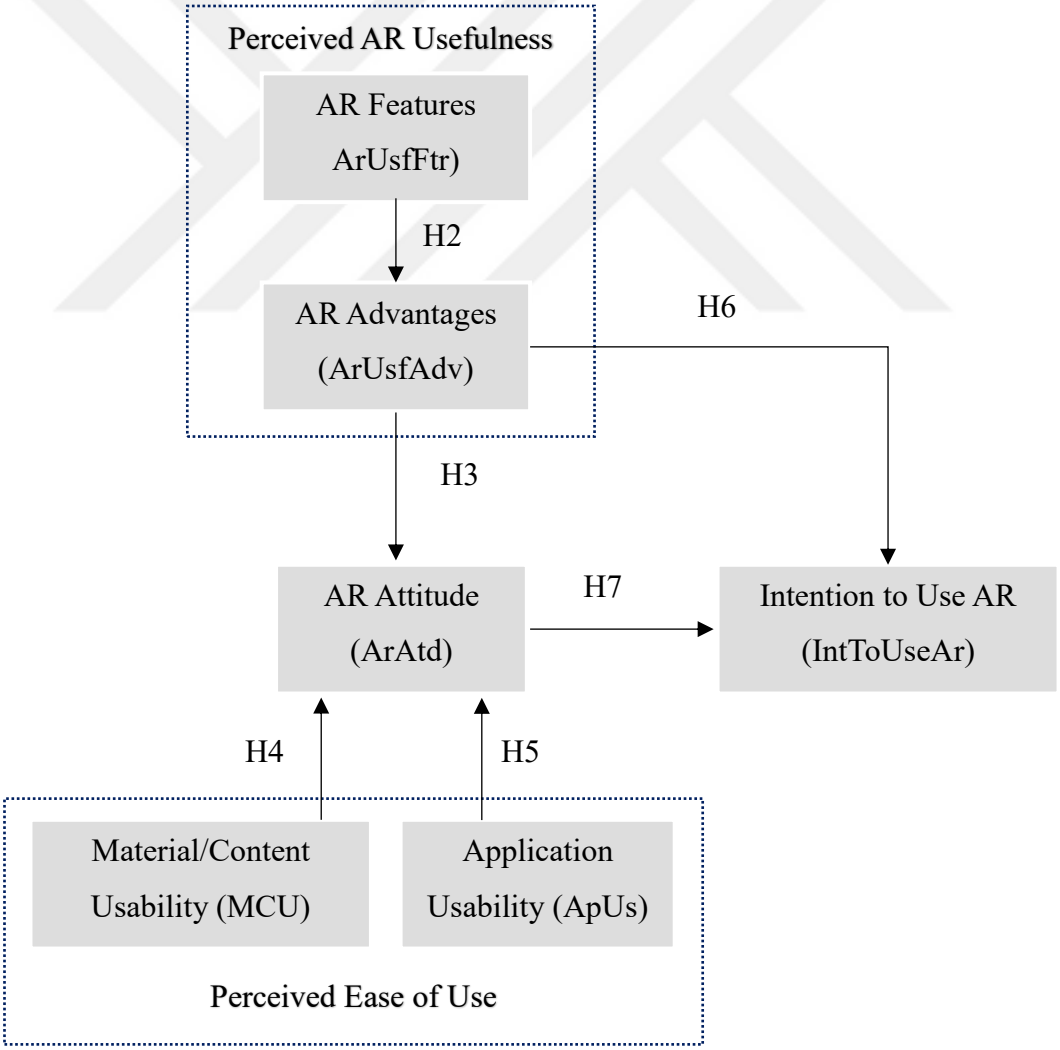


Fig. 7 Theoretical model of the study

As a result, all variables in the theoretical model have been defined based on the literature and Technology Acceptance Model. Table 2 includes the names and their abbreviations of the variables in theoretical model.

Table 2. Variable Names and Abbreviations

| Variable Name | Variable Abbreviation |
|---|---|
| Material/Content Usability | MCU |
| Application Usability | ApUs |
| AR Features | ArUsfFtr |
| AR Advantages | ArUsfAdv |
| AR Attitude | ArAtd |
| Intention to Use AR | IntToUseAr |

To test the theoretical model, the items were asked to participants by conducting an evaluation survey which will be mentioned later in the study.

# CHAPTER 4

# METHODOLOGY

This part of the thesis includes the information about the application process and details of data collection tools.

## 4.1 Preparation for the application process

This study was conducted in a corporate retail company in Turkey with the purpose of investigating the awareness and attitudes of internal trainers about AR usage in education. This company has more than 100 internal trainers who are actually subject matter experts. In addition, in the company, there is an Academy department, and nearly 20 training specialists and assistant training specialists are working there. All these people are the target audience for this research.

For reaching the research purpose, the whole process was planned carefully with the following steps: Awareness survey, training session, evaluation survey and interview. The purpose of awareness survey was to examine some descriptive data and the prior knowledge about AR before the training. In addition, the aim of the training session was to increase the knowledge level of participants about AR usage in education. Furthermore, the aim of the evaluation survey was to evaluate the change of the participants' knowledge level about AR after the training session, and to understand their tendency to use AR in their trainings. Moreover, the intention of the interview was to collect shining ideas of AR usage examples and specific views of participants about the usage of this new technology in education. All these steps are given in Fig 8.

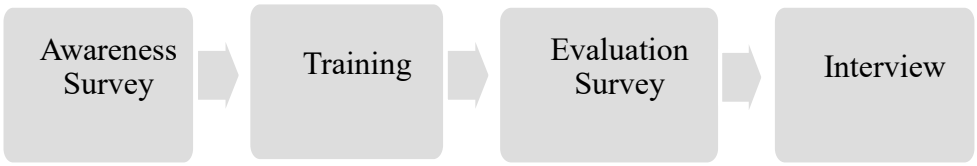


Fig. 8 The plan of the application process

One of the main issues before the application was the preparation of data collection tools and this will be detailed later in this chapter. Another crucial issue was about the preparation of training content, materials, exercises, necessary tools and applications. In order to handle this point, training method should be selected appropriately. In other words, the purpose and target audience should be investigated to define training method. The purpose of the training was to increase the knowledge level of participants about AR usage in education. In addition, the subject was related with a technical/technological issue and the target audience was from adult learners who were far away from this type of issues. According to adult learning theory, adults want to participate actively in the learning process and they need to make applications immediately (Knowles, 1980, p. 44-45). Constructivist learning is the best fitting learning approach to meet the needs of the adult learners in such a setting. For this reason, training content and exercises were planned and designed according to constructivist learning approach. As a result, training method was defined so that participants had such a chance of participating interactive, entertaining, and memorable learning experience.

The next step was the preparation of the training content. After reviewing both Turkish and English literature, the outline of training became evident (Ozarslan, 2013; Kucuk, Yılmaz, & Goktas, 2014; Somyurek, 2014; Baysan, 2015; Demirer & Erbas, 2015; Sirakaya, 2015; Sirakaya & Seferoglu, 2016).

Based on this outline, training content was prepared as a PowerPoint presentation. The time plan of training was given as in Table 3.

Table 3. Time Plan and Outline of Training

| Activity | Duration |
|---|---|
| 1. Introduction | 5 minutes |
| 2. Awareness Survey | 10 minutes |
| 3. Giving Information About…<br>• Technological Change<br>• Video: A Day in the Future<br>• Definitions of AR and VR | 15 minutes |
| 4. AR and VR Experience | 15 minutes |
| Coffee Time | 10 minutes |
| 5. Giving Information About…<br>• AR History<br>• AR Types<br>• AR Usage Areas<br>• AR Usage Examples in Training<br>• Hearth Example<br>• AR Benefits in Training<br>• AR Development Platforms | 25 minutes |
| 6. Summary | 5 minutes |
| 7. Evaluation Survey | 10 minutes |
| 8. Close-Up | 5 minutes |
| Total | 105 minutes |

Since the training was experience based, it was important to choose the suitable AR application. After investigating three AR applications (Layar, Aurasma and Blippar), Blippar has been found as the best usable one. In addition, Blippar has offered its web-based development tool for free. So, it has been decided to use Blippar in the training as AR application. By using its development tools, sample AR markers have been prepared. All provided markers were put into Word and PowerPoint documents to prepare handout materials for the activities during the training session.

Another important point of the training was to make participants differentiate AR technology from VR. As a result, there was an activity for trying cardboards to experience VR environment. For this reason, before the trainings, one of the important preparation step was to find the cardboard. All used cardboards were provided by Teleporter company, free of charge.

Training materials, example pictures, screenshots and some photos from the trainings are introduced in Appendix A. All used photos were downloaded from an official image stock website, called as iStock by Getty Image (iStock, 2016).

## 4.2 Application process

After defining the flow and duration of a group, trainings were planned for five alternative times and all target audience were divided into five groups since it was not possible to take all participants in one time. By doing this, all participants in each group have passed through the same process. Each group composed of 9 to 15 participants. Totally 61 people participated in both trainings and questionnaires (Awareness Survey and Evaluation Survey). In addition, 10 interviews were made with people from different groups. Training groups and participation summary is given in Table 4.

Table 4. Training Groups and Participation Summary

| Group No | Participants |
|---|---|
| Group 1 | 9 |
| Group 2 | 12 |
| Group 3 | 14 |
| Group 4 | 15 |
| Group 5 | 11 |
| Total | 61 |

At the beginning, after introducing the purpose of the training, participants were informed about the awareness survey and they filled out in nearly 10 to 15 minutes. Then, the trainer gave information about AR with the help of the previously prepared materials and example applications given in Appendix A. Participants experienced both VR and AR actively during the training. At the end of the training, participants were asked to complete the evaluation survey. Both awareness survey and evaluation survey were prepared in SurveyMonkey website and participants completed these online questionnaires via their mobile phones. After closing the training, some of the volunteers participated to a semi-structured interview to get the ideas of participants.

## 4.3 Data collection tools

As mentioned earlier, for reaching the research purpose, awareness survey, evaluation survey and interview were conducted. The structure of the data collection tools is summarized in Table 5.

Table 5. Structure of the Data Collection Tools

| | Part 1 | Part 2 | Part 3 | Part 4 | Part 5 | Part 6 |
|---|---|---|---|---|---|---|
| Awareness Survey | Demographic | Technology Usage | Attitude Towards Technology Usage in Education | Knowledge Questions | | |
| Evaluation Survey | Knowledge Questions | Usability Items | AR Features/ Advantages | AR Attitude | Intention to Use AR in Education | AR View Questions |
| Interview | AR Features/ Benefits | AR Limitations/ Suggestions | AR Usage in Education | | | |

#### 4.3.1 Structure of awareness survey

The questionnaire has a welcome part giving a brief information about the study, the purpose of the questionnaire and contact information about the researcher. The English and Turkish versions of awareness survey are presented in Appendix B and C. This questionnaire consists of 41 items under 16 questions and four parts as follows:

- Part 1: Demographic information
- Part 2: Technology usage
- Part 3: Attitude towards technology usage in education
- Part 4: Knowledge questions

##### 4.3.1.1 Part 1: Demographic information

This part includes five questions which are generated by the researcher to get demographic information of participants as follows:

- Name - Surname is an optional item included in both awareness and evaluation surveys.
- Gender includes “Female” and “Male” options and participants are required to choose one of these two options.
- Age is an ordinal-scale item and includes “18-25”, “26-32”, “33-42” and “43 and more”. Since the intervals in this scale could not be distributed equally, in the analysis step, there was a need for recoding the data. When investigating the data, it has been realized that the total number of participants choosing 32 or less and the total number of participants choosing 33 or more were nearly the same. Because of this equal distribution, the data were recoded as follows: “Equal and less than 32” and “More than 32”.

- Education Level is also an ordinal-scale item consisting of "Undergraduate (2 years degree)", "Undergraduate (4 years degree)", "Graduate", "Doctorate" and "Other (Please describe)".
- Position is the last question in this part including "Educational Specialist", "Assistant Educational Specialist", "Internal Trainer", and "Other (Please describe)".

#### 4.3.1.2 Part 2: Technology usage

The purpose of this part is to learn about technology usage habits of participants. This part includes five questions with totally 23 items, and two of them are scale questions. In these two scale questions, a five-point Likert-type usage scale is used ranging from "1 = Several times a month" to "5 = More than 5 hours a day". Participants are required to answer each question and each item. The questions have been compiled from the literature and scale items are generated by the researcher as shown in Table 6.

Table 6. Sources of the Questions about Technology Usage

| Item | Variable | Reference |
|---|---|---|
| Which devices do you use? | Device1 (D1) | Adapted from Fonseca et al. (2014) |
| Do you access to internet by which device mostly? | Device2 (D2) | |
| How many hours a day do you use the internet? | Internet_ Time (IT) | |
| Choose the frequency of activities you are doing with internet. | Internet_ Activity (IA) | Adapted from Fonseca et al. (2014), items were generated by researcher. |
| Choose the frequency of virtual environments usage. | Virtual_ Environments (VE) | |

#### 4.3.1.3 Part 3: Attitude towards technology usage in education

This part aims to look at participants' attitude towards technology usage in education. There are eight items under one question which is asked in a Five-point Likert-type agreement scale ranging from "1 = Strongly Disagree" to "5 = Strongly Agree". All items are generated by the researcher and participants are required to answer each of them.

#### 4.3.1.4 Part 4: Knowledge questions

The last part of the awareness survey comprises of five obligatory multiple-choice questions that are generated by the researcher. Each question has five answer options; one of which is correct, other four are wrong options. The aim of these questions is to learn about the knowledge level of the participants about Augmented Reality technology. After completing the literature review, the basic information about AR have been defined and the questions are produced from these basic points.

### 4.3.2 Structure of evaluation survey

Like awareness survey, evaluation survey has also a welcome part giving a brief information about the importance of filling this second questionnaire and contact information of researcher. The English and Turkish versions of evaluation survey are presented in Appendix D and E.

The questionnaire consists of 46 items under 16 questions and 6 parts. First item is Name – Surname which is an optional text box like in awareness survey. The parts of the questionnaires are as follows:

- Part 1: Knowledge questions
- Part 2: Usability items
- Part 3: AR features/advantages
- Part 4: AR attitude
- Part 5: Intention to use AR in education
- Part 6: AR view questions

All these following items will be detailed later.

#### 4.3.2.1 Part 1: Knowledge questions

One of the important outputs of this study is to investigate whether knowledge level of the participants changes after the training. Therefore, in this part, there are 5 multiple questions which are exactly the same as in last part of awareness survey to be able to compare the results and show the difference.

#### 4.3.2.2 Part 2: Usability items

This part of the evaluation survey includes two questions with 11 items and a five-point Likert-type agreement scale is used ranging from “1 = Strongly Disagree” to “5 = Strongly Agree”. Participants are required to answer each question and each item. The questions and items have been compiled from the literature.

First question in this part is related with Material Content Usability (MCU) variable and includes five items as shown in Table 7.

Table 7. Source of the Materials Content Usability (MCU) Question and Items

| Item | Variable | Reference |
|---|---|---|
| Evaluate the expressions about the materials and content used. | Materials_ Content_ Usability (MCU) | Adapted from Fonseca et al. (2014) |
| The materials used made it easier to understand. | MCU_1 | |
| The structure of the sessions/ exercises made it easy to understand. | MCU_2 | |
| I could easily get the idea through the application I made. | MCU_3 | |
| The information provided was satisfactory. | MCU_4 | |
| Time was used effectively. | MCU_5 | |

Second question is about Application Usability (ApUs) variable and has six items as illustrated in Table 8.

Table 8. Source of the Application Usability (ApUs) Question and Items

| Item | Variable | Reference |
|---|---|---|
| Evaluate the expressions about Augmented Reality and Virtual Reality applications. | Application_ Usability (ApUs) | Adapted from Fonseca et al. (2014) |
| I used the Augmented Reality (AR) application with ease. | ApUs_1 | |
| I did not have a technical problem when using AR. | ApUs_2 | |
| I was pleased with the AR experience. | ApUs_3 | |
| I could easily use the Virtual Reality cardboard. | ApUs_4 | |
| I did not have a technical problem during the Virtual Reality experience. | ApUs_5 | |
| I liked the Virtual Reality experience. | ApUs_6 | |

#### 4.3.2.3 Part 3: AR features/advantages

In this part of the evaluation survey, there are two questions with 17 items and a five-point Likert-type agreement scale is used ranging from "1 = Strongly Disagree" to "5 = Strongly Agree". Participants are required to answer each question and each item. The questions and items have been compiled from the literature.

First question in this part is related with AR Usefulness/Feature (ARUsfFtr) variable and includes eight items as shown in Table 9.

Table 9. Source of the AR Usefulness/Feature (ARUsfFtr) Question and Items

| Item | Variable | Reference |
|---|---|---|
| Evaluate the items about the properties of the Augmented Reality. | AR Usefulness/ Feature ARUsfFtr | Adapted from Huang et al. (2010) |
| 3D animations made me feel close to real life. | ARUsfFtr_1 | |
| 3D animations provided me to show more interest to the subject. | ARUsfFtr_2 | |
| I feel impressed from the usage of 3D animations. | ARUsfFtr_3 | |
| I would like to share my AR learning experience with my environment. | ARUsfFtr_4 | |
| Learning with AR can enhance teacher–learner interaction. | ARUsfFtr_5 | |
| Learning with AR can enhance learner–learner interaction. | ARUsfFtr_6 | |
| AR moved my imagination into action. | ARUsfFtr_7 | |
| AR encouraged me to think creatively. | ARUsfFtr_8 | |

Second question is about AR Usefulness/Advantages (ARUsfAdv) variable and has nine items as illustrated in Table 10.

Table 10. Source of the AR Usefulness/Advantages (ARUsfAdv) Question and Items

| Item | Variable | Reference |
|---|---|---|
| Evaluate the items about the advantages of the Augmented Reality. | AR Usefulness Advantages ARUsfAdv | Adapted from Huang et al. (2010) |
| AR made learning content fun. | ARUsfAdv_1 | |
| AR examples increased my learning desire. | ARUsfAdv_2 | |
| AR made me motivated to learn new information. | ARUsfAdv_3 | |
| I can find solutions to the problems that I encounter in learning environments with AR technology. | ARUsfAdv_4 | |
| AR showed me that I could find solutions in different ways. | ARUsfAdv_5 | |
| AR have contributed my problem solving skills. | ARUsfAdv_6 | |
| When I encountered the problem, I was able to ask questions to trainer easily. | ARUsfAdv_7 | |
| AR provided me the opportunity to interact with the participants. | ARUsfAdv_8 | |
| AR provided me the experience that I want to share. | ARUsfAdv_9 | |

#### 4.3.2.4 Part 4: AR attitude

In this part, there is one question with three items for investigating AR Attitude (AR_Atd) variable. The question has a five-point Likert-type agreement scale ranging from “1 = Strongly Disagree” to “5 = Strongly Agree”. Participants are required to answer each item. The question and two items have been compiled from the literature, and one item was generated by the researcher as shown in Table 11.

Table 11. Source of the AR Attitude (AR_Atd) Question and Items

| Item | Variable | Reference |
|---|---|---|
| Evaluate the items about the attitude towards Augmented Reality. | AR Attitude (AR_Atd) | Adapted from Huang et al. (2010) |
| Using AR in a learning environment is an impressive idea. | AR_Atd_1 | |
| AR contributes to increase knowledge in education. | AR_Atd_2 | Adapted from Uluyol (2014) |
| AR is a learning tool that will make a difference in education. | AR_Atd_3 | Generated by the researcher |

4.3.2.5 Part 5: Intention to use AR in education

This part includes one question with five items about Intention to Use AR (IntToUseAr) variable. The question has a five-point Likert-type agreement scale ranging from "1 = Strongly Disagree" to "5 = Strongly Agree". Participants are required to answer each item. The question and three items have been compiled from the literature, and two items were generated by the researcher as shown in Table 12.

Table 12. Source of the Intention to Use AR (IntToUseAr) Question and Items

| Item | Variable | Reference |
|---|---|---|
| Evaluate the items about using AR in the field of education. | Intention to Use AR (IntToUseAr) | Adapted from Huang et al. (2010) & Uluyol (2014) |
| I think that the use of AR in education provide advantage. | IntToUseAr_1 | Adapted from Huang et al. (2010) & Uluyol (2014) |
| I would like to know more about AR. | IntToUseAr_2 | Generated by researcher |
| I would like to get more experience about AR. | IntToUseAr_3 | Generated by researcher |
| I would like to see AR technology in every training I participate. | IntToUseAr_4 | Adapted from Huang et al. (2010) & Uluyol (2014) |
| I want to use AR applications in my trainings. | IntToUseAr_5 | Adapted from Huang et al. (2010) |

#### 4.3.2.6 Part 6: AR view questions

This part aims to get different ideas and opinions of participants in an unstructured way for getting more creative results by using four open-ended questions, all of which have been generated by the researcher. After completing these questions, participants could finish the evaluation survey.

### 4.3.3 Structure of the interview

The English and Turkish versions of interview questions are presented in Appendix F and G. A semi-structured interview form was prepared before the training including several questions under three parts as follows:

- Part 1: AR features/benefits
- Part 2: AR limitations/suggestions
- Part 3: AR use in education

Participation to interview was a voluntary activity and there were 10 people who had the willingness to answer interview questions and to share their ideas. After each training, the interviews are planned, and data are collected through these meetings. In the next chapter, all data analyses and findings will be detailed.

## 4.4 Methods used in the analysis

Methods used to analyze the collected data are as follows: paired sample t-test, regression, ANOVA and independent samples t-test.

### 4.4.1 Paired sample t-test analysis

The knowledge questions in awareness survey represented the prior knowledge of participants about AR before the training. On the other hand, the knowledge questions in evaluation survey which were completely the same with the one in awareness survey represented the knowledge level of participants about AR after the training. For testing whether there is a significant difference on the knowledge level of participants before and after the training session, paired sample t-test was used, and the related hypothesis was as follows:

- Hypothesis 1 (H1): There will be an increase in the level of knowledge after classroom practice.

### 4.4.2 Regression analyses

Regression analysis is used for illustrating the effect of independent variables on a dependent variable. In this study's theoretical model, there are three hypotheses and five independent variables affecting a dependent variable. In order to test the theoretical model, three separate regressions were conducted as follows:

To test the effect of AR features on AR advantages, simple linear regression analysis was conducted. The data related with AR features and AR advantages were collected via third part of evaluation survey. The hypothesis was as follows:

- Hypothesis 2 (H2): AR features have a positive effect on AR advantages.

To test the effect of AR advantages, material/content usability and application usability on AR attitude multiple regression analysis was conducted. The data related with AR advantages, material/content usability, application usability and AR attitude were collected via second, third and fourth parts of evaluation survey. The hypothesis was as follows:

- Hypothesis 3 (H3): AR advantages, material/content usability and application usability have a positive effect on AR attitude.

To test the effect of AR advantages and AR attitude on AR usage intention multiple regression analysis was conducted. The data related with AR advantages, AR attitude and AR usage intention were collected via third, fourth and fifth parts of evaluation survey. The hypothesis was as follows:

- Hypothesis 4 (H4): AR advantages and AR attitude have a positive effect on AR usage intention.

### 4.4.3 ANOVA analysis

ANOVA is known as the analysis of variance and this test is used when a difference between two or more groups with respect to any interval or ratio scale variable needs to be investigated.

To test whether there is a significant difference on AR Usage Intention among the education levels, ANOVA test was conducted. The data of education level of participants were taken from the first part of the awareness survey whereas the data of AR Usage Intention were collected via the fifth part of the evaluation survey. The hypothesis was as follows:

- Hypothesis 5 (H5): There is a significant difference on AR Usage Intention among the education levels.

### 4.4.4 Independent samples t-test analyses

Independent samples t-test is used to compare the means of a normally distributed dependent variable for two independent groups. In this study, three different independent samples t-test analyses have been done for testing whether there is a significant difference on AR Usage Intention between the positions, genders, and age groups.

The data of position, gender and age group of participants were taken from the first part of awareness survey whereas the data of AR Usage Intention were collected via the fifth part of the evaluation survey. The related hypotheses are as follows:

- Hypothesis 6 (H6): There is a significant difference on AR Usage Intention between the positions.
- Hypothesis 7 (H7): There is a significant difference on AR Usage Intention between males and females.
- Hypothesis 8 (H8): There is a significant difference on AR Usage Intention between the age groups.

# CHAPTER 5

# ANALYSES AND FINDINGS

In this part of the study; descriptive statistics of findings, reliability analysis of scales, normality of scales, paired sample t-test analysis between awareness survey and evaluation survey, regression analysis between dependent and independent variables, ANOVA analysis and independent samples t-test analyses are conducted, and results are examined. IBM SPSS Statistics 23 is used to apply methods described in Chapter 4. In addition to these analyses, answers of participants to the open-ended questions and interview questions are examined at the last part of this chapter.

## 5.1 Descriptive findings

Descriptive analyses are done for:

- Demographic profile
- Technology usage profile
- Internet activity scale
- Virtual environments scale
- Educational technology attitude scale
- Materials and content usability scale
- Application usability scale
- AR usefulness features scale
- AR usefulness advantages scale
- Augmented reality attitude scale
- Intention to use AR scale

5.1.1 Demographic profile of respondents

Demographic characteristics of participants are received from awareness survey. Frequency and percentage information for gender, age, education level, and position profile of respondents are shown in Table 13.

Table 13. Demographic Profile of Respondents

| Gender | | |
|---|---|---|
| | Frequency | Percent |
| Female | 35 | 57.4 |
| Male | 26 | 42.6 |
| Total | 61 | 100 |
| Age | | |
| | Frequency | Percent |
| Equal and less than 32 | 30 | 49.2 |
| More than 32 | 31 | 50.8 |
| Total | 61 | 100.0 |
| Education Level | | |
| | Frequency | Percent |
| High school | 4 | 6.6 |
| Undergraduate (2 years degree) | 5 | 8.2 |
| Undergraduate (4 years degree) | 35 | 57.4 |
| Graduate | 17 | 27.9 |
| Total | 61 | 100.0 |
| Position | | |
| | Frequency | Percent |
| Internal Trainer | 38 | 62.3 |
| Educational Specialist | 17 | 27.9 |
| Assistant Educational Specialist | 3 | 4.9 |
| Office Assistant | 3 | 4.9 |
| Total | 61 | 100.0 |

According to the Table 13, 57.4% of participants are female and 42.6% of them are male. At first, an ordinal scale is placed to see the age profile as follows: “18-25”, “26-32”, “33-42” and “43 and more”. Then, since the intervals in this scale could not be distributed equally, there was a need for recoding the data. When investigating the data, it has been realized that the total number of participants choosing 32 or less and the total number of participants choosing 33 or more were nearly the same. Because of this equal distribution, the data were recoded as follows: “Equal and less than 32” and “More than 32”. 49.2% of respondents are in the group of “Equal and less than 32” whereas 50.8% of them are in the other group of “More than 32”.

Sample consists of people from different education levels. 6.6% of them are high school graduates, 8.2% of them are 2 years university graduates, 57.4% of them has 4 years university degree and 27.9% of them has graduate degree. While there is a variety in terms of education level, most of the participants have bachelor’s degree.

According to table, there are four types of positions among participants. 62.3% of them are internal trainers, 27.9% of them are educational specialists, 4.9% of them are assistant educational specialists, and 4.9% of them are office assistants. Looking from the position perspective, first two groups are active trainers, but the last two groups are at preparation step for giving training. Last group will prepare their own trainings after a period of job experience. Therefore, they are accepted as the part of target audience of this study.

5.1.2 Technology usage profile of respondents

Technology usage profile of respondents are illustrated in Table 14. In the first part, Table 14 shows the summary of device usage preferences of participants. Laptop and smartphone are mostly owned device types. Tablet is also a preferred device type with 54.1% ratio. 18% of participants own desktop computer and 1.6% of them have a Kindle device.

Table 14. Technology Usage Profile of Respondents

| Device Ownership | | |
|---|---|---|
| | Frequency | Percent |
| Laptop | 56 | 91.8 |
| Desktop | 18 | 29.5 |
| Tablet | 33 | 54.1 |
| Smart Phone | 56 | 91.8 |
| Kindle | 1 | 1.6 |
| Total: 61 | | |
| Mostly Used Internet Access Device | | |
| | Frequency | Percent |
| Laptop | 10 | 16.4 |
| Desktop | 1 | 1.6 |
| Smart Phone | 50 | 82.0 |
| Total | 61 | 100.0 |
| Internet Access Time (hour/day) | | |
| | Frequency | Percent |
| Less than 1 hour | 3 | 4.9 |
| 1-3 hours | 16 | 26.2 |
| 4-6 hours | 17 | 27.9 |
| 7-9 hours | 12 | 19.7 |
| 10 hours and more | 13 | 21.3 |
| Total | 61 | 100.0 |

Participants access internet via Desktop computers with the ratio of 1.6%, via Laptop with the ratio of 16.4% and via Smart Phone with the ratio of 82.0%. As a result, participants mostly use smart phone as device type and they also prefer to access to internet via smart phones.

While looking at the time passing on the internet, 4.9% of participants chose "Less than 1 hour" option, 26.2% of them selected "1-3 hours" option, 27.9% of them preferred "4-6 hours" option, 19.7% of them selected "7-9 hours" option and 21.3% of them chose "10 hours and more" option. According to the results, internet access times of the respondents in a day seemed high.

### 5.1.3 Descriptive statistics for internet activity scale

This part of awareness survey shows the tendency of participants' internet activities for the stated purposes in Table 15. There are 11 items in the scale and respondents are asked to answer the question on a 5-point frequency scale (1: Several times a month, 2: Several times a week, 3: Several times a day, 4: 1-5 hours per day, 5: More than 5 hours a day).

According to the results in Table 15, participants have tendency to do research, check e-mails, follow news and visit social networking sites since their responses are higher than the average value (3.00). On the other hand, participants also have a lower tendency to do chatting and listen/watch music/video since their responses are lower than the average value (3.00). In addition, participants have a little tendency do online shopping, download file, update blog, follow e-government procedures and play games sites since their responses are at very low level.

Table 15. Mean Values of Internet Activity Scale

| | N | Mean | Std. Deviation |
|---|---|---|---|
| a. I do research. | 61 | 3.44 | 1.057 |
| b. I check my e-mails. | 61 | 4.00 | 1.000 |
| c. I follow news. | 61 | 3.38 | 0.711 |
| d. I update my blog. | 61 | 0.51 | 0.960 |
| e. I follow e-government procedures. | 61 | 0.90 | 0.700 |
| f. I visit social networking sites. (Facebook, twitter, etc.) | 61 | 3.25 | 0.994 |
| g. I do chat. | 61 | 2.79 | 1.473 |
| h. I do online shopping. | 61 | 1.48 | 0.849 |
| i. I listen / I watch music, video, etc. | 61 | 2.93 | 1.237 |
| j. I download file. | 61 | 2.05 | 1.007 |
| k. I play game. | 61 | 0.98 | 1.310 |
| Valid N (listwise) | 61 | | |

5.1.4 Descriptive statistics for virtual environments scale

This part of awareness survey shows the tendency of participants' usage of virtual environments for the stated items in Table 16. There are 9 items in the scale and respondents are asked to answer the question on a 5-point frequency scale (1: Several times a month, 2: Several times a week, 3: Several times a day, 4: 1-5 hours per day, 5: More than 5 hours a day)

Table 16. Mean Values of Virtual Environments Scale

| | N | Mean | Std. Deviation |
|---|---|---|---|
| a. Facebook | 61 | 2.74 | 1.196 |
| b. Twitter | 61 | 1.44 | 1.444 |
| c. Instagram | 61 | 2.51 | 1.523 |
| d. Pinterest | 61 | 0.77 | 1.101 |
| e. WhatsApp | 61 | 3.84 | 0.734 |
| f. E-mail | 61 | 3.93 | 1.047 |
| g. YouTube | 61 | 3.00 | 1.111 |
| h. Blogs/Wiki's | 61 | 2.00 | 1.378 |
| i. Game sites | 61 | 0.51 | 0.960 |
| Valid N (listwise) | 61 | | |

Table 16 shows that respondents have tendency to use WhatsApp and E-mail, since their responses are slightly higher than the average value (3.00). In addition, they have lower tendency to use YouTube since the responses are equal to the average value (3.00). However, respondents have less tendency to use Facebook, Twitter, Instagram and Blog/Wiki since their responses are lower than the average value (3.00). Furthermore, respondents have little tendency to use Pinterest and Game sites since their responses are at very low level.

5.1.5 Descriptive statistics for educational technology attitude scale

This part of awareness survey attempts to measure the attitude of participants' technology usage in education for the stated items in Table 17. There are 8 items in the scale and respondents are asked to answer the question on a 5-point agreement scale (1: Strongly Disagree, 2: Disagree, 3: Not Sure, 4: Agree, 5: Strongly Agree)

Table 17. Mean Values of Educational Technology Attitude Scale

| | N | Mean | Std. Deviation |
|---|---|---|---|
| a. I find the technology usage in education to be beneficial. | 61 | 4.61 | 0.802 |
| b. I am not open to development about the innovations in Education Technologies. | 61 | 4.66 | 0.655 |
| c. I am eager to learn about Trends in Education Technologies. | 61 | 4.66 | 0.655 |
| d. I am curious to apply innovations in Education Technologies. | 61 | 4.54 | 0.697 |
| e. I find the use of technology in education to be insignificant. | 61 | 4.57 | 0.805 |
| f. I have enough knowledge about the Augmented Reality. | 61 | 2.57 | 0.865 |
| g. I would like to learn new information about Augmented Reality. | 61 | 4.57 | 0.670 |
| h. I would like to make practices for Augmented Reality. | 61 | 4.46 | 0.743 |
| Valid N (listwise) | 61 | | |

Results shows that participants find technology usage in education to be beneficial, they are eager to learn about trends in education technologies and they are curious to apply innovations in education technologies at high level. Items “b” and “e” are recoded before the analysis since they are reverse items. Therefore, results of these two items are at high level. In addition, participants do not have enough knowledge about AR, they want to learn about AR and they want to make practices for AR at very high level. As a result, participants’ attitude for educational technology usage seems positive at high level since their responses are much higher than the average value (3.00).

5.1.6 Descriptive statistics for materials and content usability

This part of evaluation survey attempts to measure the views of participants about material and content usability for the stated items in Table 18. There are 5 items in the scale and respondents are asked to answer the question on a 5-point agreement scale (1: Strongly Disagree, 2: Disagree, 3: Not Sure, 4: Agree, 5: Strongly Agree)

Table 18. Mean Values of Materials and Content Usability

| | N | Mean | Std. Deviation |
|---|---|---|---|
| a. The materials used made it easier to understand. | 61 | 4.54 | 0.621 |
| b. The structure of the sessions/exercises made it easy to understand. | 61 | 4.41 | 0.616 |
| c. I could easily get the idea through the application I made. | 61 | 4.38 | 0.662 |
| d. The information provided was satisfactory. | 61 | 4.20 | 0.703 |
| e. Time was used effectively. | 61 | 4.38 | 0.711 |
| Valid N (listwise) | 61 | | |

Participants stated that they used materials easily, they could easily understand the exercises, and they were satisfied with the content and time management. As a result, respondents find materials and content as usable at high levels since their responses are much higher than the average value (3.00).

5.1.7 Descriptive statistics for application usability

This part of evaluation survey attempts to measure the views of participants about application usability for the stated items in Table 19. There are 6 items in the scale and respondents are asked to answer the question on a 5-point agreement scale (1: Strongly Disagree, 2: Disagree, 3: Not Sure, 4: Agree, 5: Strongly Agree)

Table 19. Mean Values of Application Usability

| | N | Mean | Std. Deviation |
|---|---|---|---|
| a. I used the Augmented Reality application with ease. | 61 | 4.36 | 0.684 |
| b. I did not have a technical problem when using AR. | 61 | 4.11 | 0.915 |
| c. I was pleased with the AR experience. | 61 | 4.46 | 0.697 |
| d. I could easily use the Virtual Reality cardboard. | 61 | 4.20 | 0.726 |
| e. I did not have a technical problem during the Virtual Reality experience. | 61 | 4.23 | 0.804 |
| f. I liked the Virtual Reality experience. | 61 | 4.39 | 0.640 |
| Valid N (listwise) | 61 | | |

Participants stated that they easily used the application, and they were pleased with both AR and VR experience at high level. Moreover, the usage of cardboard was slightly easier than the usage of AR application, but both were rated at high level. Participants might encounter some technical problems via AR application usage, but the item was still rated at high level. As a result, respondents' view about application usability seems positive at high levels since their responses are much higher than the average value (3.00).

### 5.1.8 Descriptive statistics for AR usefulness features

This part of evaluation survey attempts to measure the views of participants about AR features for the stated items in Table 20. There are 8 items in the scale and respondents are asked to answer the question on a 5-point agreement scale (1: Strongly Disagree, 2: Disagree, 3: Not Sure, 4: Agree, 5: Strongly Agree)

Table 20. Mean Values of AR Usefulness Features

| | N | Mean | Std. Deviation |
|---|---|---|---|
| a. 3D animations made me feel close to real life. | 61 | 4.20 | 0.703 |
| b. 3D animations provided me to show more interest to the subject. | 61 | 4.38 | 0.522 |
| c. I feel impressed from the usage of 3D animations. | 61 | 4.38 | 0.553 |
| d. I would like to share my AR learning experience with my environment. | 61 | 4.46 | 0.621 |
| e. Learning with AR can enhance teacher–learner interaction. | 61 | 4.39 | 0.640 |
| f. Learning with AR can enhance learner–learner interaction. | 61 | 4.30 | 0.691 |
| g. AR moved my imagination into action. | 61 | 4.36 | 0.684 |
| h. AR encouraged me to think creatively. | 61 | 4.39 | 0.640 |
| Valid N (listwise) | 61 | | |

According to responses of participants, all the items measuring AR features are at high levels. The features in this scale are mostly related with immersion, interaction and imagination. These results show that participants have experienced all these features during the training session and respondents' view about AR features seems positive at high levels since their responses are much higher than the average value (3.00).

5.1.9 Descriptive statistics for AR usefulness advantages

This part of evaluation survey attempts to measure the views of participants about AR advantages for the stated items in Table 21. There are 9 items in the scale and respondents are asked to answer the question on a 5-point agreement scale (1: Strongly Disagree, 2: Disagree, 3: Not Sure, 4: Agree, 5: Strongly Agree)

Table 21. Mean Values of AR Usefulness Advantages

| | N | Mean | Std. Deviation |
|---|---|---|---|
| a. AR made learning content fun. | 61 | 4.57 | 0.499 |
| b. AR examples increased my learning desire. | 61 | 4.52 | 0.536 |
| c. AR made me motivated to learn new information. | 61 | 4.54 | 0.535 |
| d. I can find solutions to the problems that I encounter in learning environments with AR technology. | 61 | 4.08 | 0.640 |
| e. AR showed me that I could find solutions in different ways. | 61 | 4.31 | 0.564 |
| f. AR has contributed to my problem solving skills. | 61 | 4.02 | 0.741 |
| g. When I encountered the problem, I was able to ask questions to trainer easily. | 61 | 4.48 | 0.566 |
| h. AR provided me the opportunity to interact with the participants. | 61 | 4.30 | 0.615 |
| i. AR provided me the experience that I want to share. | 61 | 4.52 | 0.536 |
| Valid N (listwise) | 61 | | |

According to responses of participants in Table 21, all the items measuring AR features are at high levels. Motivation related items; “a”, “b”, “c”, are at very high levels. In addition, “g”, “h” and “i” are collaboration related items and they are at very high levels. Problem-solving ability related items; “d”, “e” and “f”, are also at high levels. These results show that participants have experienced the advantages of AR during the training session and their view about AR advantages seems positive at high levels since their responses are much higher than the average value (3.00).

### 5.1.10 Descriptive statistics for AR attitude

This part of evaluation survey attempts to measure the attitude of participants about AR usage in training for the stated items in Table 22. There are 3 items in the scale and respondents are asked to answer the question on a 5-point agreement scale (1: Strongly Disagree, 2: Disagree, 3: Not Sure, 4: Agree, 5: Strongly Agree)

According to responses of participants, all the items measuring attitude towards AR usage in training are at very high levels. These results show that participants have positive attitudes toward usage of AR in their trainings since their responses are much higher than the average value (3.00).

Table 22. Mean Values of AR Attitude

| | N | Mean | Std. Deviation |
|---|---|---|---|
| a. Using AR in a learning environment is an impressive idea. | 61 | 4.51 | 0.536 |
| b. AR contributes to increase knowledge in education. | 61 | 4.44 | 0.563 |
| c. AR is a learning tool that will make a difference in education. | 61 | 4.52 | 0.536 |
| Valid N (listwise) | 61 | | |

5.1.11 Descriptive statistics for intention to use AR

This part of evaluation survey attempts to measure the intention of participants about AR usage in training for the stated items in Table 23. There are 5 items in the scale and respondents are asked to answer the question on a 5-point agreement scale (1: Strongly Disagree, 2: Disagree, 3: Not Sure, 4: Agree, 5: Strongly Agree)

According to responses of participants, all the items measuring intention to use AR in training are at very high levels. These results show that participants have intention to use AR in their trainings since their responses are much higher than the average value (3.00).

Table 23. Mean Values of Intention to Use AR

| | N | Mean | Std. Deviation |
|---|---|---|---|
| a. I think that the use of AR in education provides advantage. | 61 | 4.54 | 0.565 |
| b. I would like to know more about AR. | 61 | 4.69 | 0.501 |
| c. I would like to get more experience about AR. | 61 | 4.61 | 0.556 |
| d. I would like to see AR technology in every training I participate. | 61 | 4.31 | 0.720 |
| e. I want to use AR applications in my trainings. | 61 | 4.44 | 0.620 |
| Valid N (listwise) | 61 | | |

5.2 Reliability/internal consistency of the survey items and scales

Reliability of survey items have been analyzed by Cronbach's Alpha for the following nine scales; internet activity scale, virtual environments scale, educational technology attitude scale, materials and content usability scale, application usability scale, AR usefulness features scale, AR usefulness advantages scale, AR attitude scale, and intention to use AR scale. Expected value is 0.7 and more, thus, all scales apart from Virtual environments are highly reliable. The results are shown in Table 24.

Table 24. Reliability Analysis of Scales

| Variables | Number of Items | Cronbach's Alpha |
|---|---|---|
| Internet activity (IA) | 11 | 0.725 |
| Virtual environments (VE) | 9 | 0.694 |
| Educational technology attitude (ETA) | 8 | 0.718 |
| Materials and content usability (MCU) | 5 | 0.901 |
| Application usability (ApUs) | 6 | 0.871 |
| AR usefulness features (ArUsfFtr) | 8 | 0.916 |
| AR usefulness advantages (ArUsfAdv) | 9 | 0.920 |
| Augmented reality attitude (ArAtd) | 3 | 0.838 |
| Intention to use AR (IntToUseAr) | 5 | 0.893 |

As shown in Table 24, Cronbach's Alpha value of Virtual Environments Scale is 0.694 which is slightly lower than 0.7. To increase this value, an additional analysis was done and two items were deleted. Table 25 shows Cronbach's alpha value as 0.725 after two items are deleted.

Table 25. Cronbach's Alpha Value of Virtual Environments Scale

| Number of Items | Cronbach's Alpha |
|---|---|
| 7 | 0.725 |

## 5.3 Normality analyses

After looking at reliability results, Skewness and Kurtosis normality tests are applied to understand whether data are normally distributed. At first, the average values of each scale are calculated, using these values normality tests are applied and results are illustrated in Table 26.

Table 26. Normality Statistics

| Variables | Skewness | Kurtosis |
|---|---|---|
| Educational technology attitude (AvgETA) | -2.882 | 13.045 |
| Materials and content usability (AvgMCU) | -1.440 | 4.533 |
| Application usability (AvgApUs) | -1.118 | 2.498 |
| AR usefulness features (AvgArUsfFtr) | -0.586 | 1.388 |
| AR usefulness advantages (AvgArUsfAdv) | -0.033 | -0.755 |
| Augmented reality attitude (AvgArAtd) | -0.219 | -1.311 |
| Intention to use AR (AvgIntToUseAr) | -0.687 | -0.252 |

In a normally distributed data, Skewness and Kurtosis values are waited to be between -2 and +2 for 5% significance interval. According to the results, educational technology attitude scale could not be accepted as normally distributed, and thus this variable was not added to the research model.

Although Kurtosis value of materials and content usability scale seems higher than +2, this value is acceptable as normally distributed due to small sample size. As a result, except from educational technology attitude scale; materials and content usability, application usability, AR usefulness features, AR usefulness advantages, Augmented Reality attitude and intention to use AR are accepted as normally distributed and used as variables in the research model.

Since sample size is 61 and data are normally distributed, hypotheses are analyzed with parametric tests as given in Chapter 4. Analysis findings will be detailed in the following parts.

## 5.4 Paired sample t-test results

For testing whether there is a significant difference on the knowledge level of participants before and after the training session, hypothesis 1 was tested by using paired sample t-test and the result will be given in this part.

### 5.4.1 Hypothesis 1

To test hypothesis 1, "There will be an increase in the level of knowledge after classroom practice", a paired samples t-test was conducted for comparing the results of participants' responses for knowledge questions on awareness survey with the ones on evaluation survey. Table 27 shows the mean and standard deviation values for knowledge level in awareness survey ($M$=1.704, $SD$=1.069) and in evaluation survey ($M$=4.082, $SD$=0.988). Mean value of evaluation survey is significantly higher than mean value of awareness survey. In addition, table 28 shows the correlation of knowledge level between awareness survey and evaluation survey with $r$ value of 0.228.

Table 27. Paired Samples Statistics for Awareness and Evaluation Surveys

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | PreTotal | 1.7049 | 61 | 1.06996 | 0.13699 |
| | PostTotal | 4.0820 | 61 | 0.98818 | 0.12652 |

Table 28. Paired Samples Correlations

| | | N | Correlation | Sig. |
|---|---|---|---|---|
| Pair 1 | PreTotal and PostTotal | 61 | 0.228 | 0.077 |

Table 29 illustrates the results of Paired Samples t-test for the knowledge level of participants before and after the training session.

Table 29. Paired Samples Test

| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference Lower | Upper | | | |
| Pair 1 | PreTotal - PostTotal | -2.37705 | 1.28016 | 0.16391 | -2.70491 | -2.04919 | -14.502 | 60 | 0.000 |

There was a significant difference on the average of participants' knowledge level between awareness survey and evaluation survey with result of the following values: $t(60) = -14.502$, $p < 0.05$. These results suggest that there was a significant increase in the level of knowledge after classroom practice. This means that Hypothesis 1 is significantly supported.

## 5.5 Regression analysis results

In this study's theoretical model, there are three hypotheses and five independent variables affecting a dependent variable. Regression analysis has been performed to figure out the effects of AR feature on AR advantages, to discover the effects of material/content usability, application usability and AR advantages on AR attitude, and to observe the effects of AR advantages and AR attitude on intention to use AR.

Before conducting regression analyses, the average values of the variables were calculated and added to data with these names: AvgArUsfFtr, AvgArUsfAdv, AvgMCU, AvgApUs, AvgArAtd and AvgIntToUseAr. In order to test the theoretical model, three separate regression were conducted as follows:

### 5.5.1 Hypothesis 2

To test hypothesis 2 (H2) "AR features have a positive effect on AR advantages", simple linear regression analysis was conducted to investigate the effect of AR features on AR advantages. For testing H2, AR features was accepted as independent variable, AR advantages was accepted as dependent variable and analysis was performed.

In Table 31, ANOVA Analysis result shows that significance level is under 0.05 and thus the result is significant. In the Table 30, model summary shows that *R* value is 0.829 and *R* square is 0.688 which mean that there is a strong relationship between AR features and AR advantages. AR features explains 68.8% of the variation in AR advantages.

Table 30. Model Summary for H2

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.829[a] | 0.688 | 0.683 | 0.25725 |
| a. Predictors: (Constant), AvgArUsfFtr | | | | |

Table 31. ANOVA Analysis for H2

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 8.611 | 1 | 8.611 | 130.119 | 0.000[b] |
| | Residual | 3.905 | 59 | 0.066 | | |
| | Total | 12.516 | 60 | | | |
| a. Dependent Variable: AvgArUsfAdv | | | | | | |
| b. Predictors: (Constant), AvgArUsfFtr | | | | | | |

From the coefficient table (Table 32), coefficient of AR features is significant with a value of 0.752, so AR features has a strong positive effect on AR advantages. AR Features (ArUsfFtr) can be used in the equation as a predictor of AR advantages. Thus, hypothesis 2 is significantly supported and equation can be written as below:

AR Advantages = 1.094 + 0.752 ArUsfFtr + Ɛ

Table 32. Coefficients for H2

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 1.094 | 0.289 | | 3.783 | 0.000 |
| | AvgArUsfFtr | 0.752 | 0.066 | 0.829 | 11.407 | 0.000 |
| a. Dependent Variable: AvgArUsfAdv | | | | | | |

5.5.2 Hypothesis 3

To test hypothesis 3 (H3) “AR advantages, material/content usability and application usability have a positive effect on AR attitude.”, multiple regression analysis was conducted. For testing H3, AR advantages, material/content usability and application usability were accepted as independent variables while AR attitude was accepted as dependent variable.

In Table 34, ANOVA Analysis result shows that significance level is under 0.05 and thus the result is significant. In the Table 33, model summary shows that *R* value is 0.883 and *R* square is 0.780 which mean that there is a strong relationship between the independent variables which are AR advantages, material/content usability and application usability and dependent variable which is AR attitude. Independent variables explain 78% of the variation in AR attitude, but there is a need for investigating Table 35 to understand which one affects more.

Table 33. Model Summary for H3

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.883[a] | 0.780 | 0.768 | 0.22801 |
| a. Predictors: (Constant), AvgArUsfAdv, AvgMCU, AvgApUs | | | | |

Table 34. ANOVA Analysis for H3

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 10.505 | 3 | 3.502 | 67.354 | 0.000[b] |
| | Residual | 2.963 | 57 | 0.052 | | |
| | Total | 13.468 | 60 | | | |
| a. Dependent Variable: AvgArAtd | | | | | | |
| b. Predictors: (Constant), AvgArUsfAdv, AvgMCU, AvgApUs | | | | | | |

From the coefficients table (Table 35), coefficient of AR advantages is significant ($p$=0.000) with a value of 0.693. So, AR advantages (ArUsfAdv) can be used in the equation as a predictor of AR attitude.

From Table 35, coefficient of material/content usability is significant with 0.01 alpha level ($p$=0.059) and with a value of 0.147, and thus material/content usability (MCU) can be used in the equation as a predictor of AR attitude.

From Table 35, coefficient of application usability is not significant ($p$=0.166) with a value of 0.106. Application usability (ApUs) has no effect on AR Attitude and thus it cannot be used in the equation as a predictor of AR attitude.

According to these results, AR advantages has a strong positive effect on AR attitude, material/content usability has also an effect on AR attitude. Another result is that AR advantages has higher effect than material/content usability on AR attitude. To sum up, hypothesis 3 is supported with the following equation:

AR Attitude = 0.365 + 0.693 ArUsfAdv + 0.147 MCU + Ɛ

Table 35. Coefficients for H3

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 0.365 | 0.292 | | 1.248 | 0.217 |
| | AvgArUsfAdv | 0.693 | 0.088 | 0.668 | 7.846 | 0.000 |
| | AvgMCU | 0.147 | 0.076 | 0.175 | 1.926 | 0.059 |
| | AvgApUs | 0.106 | 0.075 | 0.131 | 1.402 | 0.166 |
| a. Dependent Variable: AvgArAtd | | | | | | |

5.5.3 Hypothesis 4

To test hypothesis 4 (H4) “AR advantages and AR attitude have a positive effect on AR usage intention”, multiple regression analysis was conducted. For testing H4, AR advantages and AR attitude were accepted as independent variables while AR usage intention was accepted as dependent variable.

In Table 37, ANOVA Analysis result shows that significance level is under 0.05 and thus the result is significant. In the Table 36, model summary shows that $R$ value is 0.8183 and $R$ square is 0.670 which mean that there is a strong relationship between the independent variables which are AR advantages and AR attitude and dependent variable which is AR usage intention. Independent variables explain 67%

of the variation in AR usage intention, but there is a need for investigating Table 38 to understand which one affects more.

Table 36. Model Summary for H4

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | 0.818[a] | 0.670 | 0.659 | 0.29208 |
| a. Predictors: (Constant), AvgArUsfAdv, AvgArAtd | | | | |

Table 37. ANOVA Analysis for H4

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 10.042 | 2 | 5.021 | 58.855 | 0.000[b] |
| | Residual | 4.948 | 58 | 0.085 | | |
| | Total | 14.990 | 60 | | | |
| a. Dependent Variable: AvgIntToUseAr | | | | | | |
| b. Predictors: (Constant), AvgArUsfAdv, AvgArAtd | | | | | | |

From the coefficients table (Table 38), coefficient of AR advantages is significant with 0.05 alpha level ($p$=0.017) and with a value of 0.397 so AR advantages (ArUsfAdv) can be used in the equation as a predictor of AR usage intention.

From Table 38, coefficient of AR attitude is significant with 0.05 alpha level ($p$=0.002) and with a value of 0.512, and thus AR attitude (ArAtd) can be used in the equation as a predictor of AR usage intention.

According to these results, AR advantages and AR attitude have a strong positive effect on AR usage intention. Another result is that AR attitude has higher effect than AR advantages on AR usage intention. To sum up, hypothesis 4 is supported with the following equation:

AR Usage Intention = 0.481 + 0.397 ArUsfAdv + 0.512 ArAtd + Ɛ

Table 38. Coefficients for H4

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | | |
| 1 | (Constant) | 0.481 | 0.375 | | 1.285 | 0.204 |
| | AvgArUsfAdv | 0.397 | 0.161 | 0.363 | 2.464 | 0.017 |
| | AvgArAtd | 0.512 | 0.155 | 0.486 | 3.299 | 0.002 |
| a. Dependent Variable: AvgIntToUseAr | | | | | | |

## 5.6 ANOVA analysis results

For figuring out the education level effect on intention to use AR, hypothesis 5 was analyzed with ANOVA test and the results will be given in this part.

### 5.6.1 Hypothesis 5

Respondents were grouped according to their education levels as high school, undergraduate (2 years degree), undergraduate (4 years degree), graduate, and doctorate. In the awareness survey, the last four options and “Other” option were asked to the respondents. Some participants chose “Other” option and entered “High school” into the textbox. So, “High school” was added to the data before the analysis step. In addition, there was nobody in the sample who chose doctorate degree, so doctorate degree is removed before the analysis step.

To test hypothesis 5 (H5) “There is a significant difference on AR Usage Intention among the education levels”, ANOVA test was conducted to explore whether there was a significant difference among these 4 groups with respect to their AR usage intention. Table 39 shows the mean values of education levels.

Table 39. Descriptive for H5

| AvgIntToUseAr | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | 95% Confidence Interval for Mean | | Minimum | Maximum |
| | N | Mean | Std. Deviation | Std. Error | Lower Bound | Upper Bound | | |
| 1 | 5 | 4.6000 | 0.46904 | 0.20976 | 4.0176 | 5.1824 | 4.00 | 5.00 |
| 2 | 35 | 4.4971 | 0.46367 | 0.07837 | 4.3379 | 4.6564 | 3.40 | 5.00 |
| 3 | 17 | 4.4824 | 0.60025 | 0.14558 | 4.1737 | 4.7910 | 3.00 | 5.00 |
| 4 | 4 | 4.7500 | 0.50000 | 0.25000 | 3.9544 | 5.5456 | 4.00 | 5.00 |
| Total | 61 | 4.5180 | 0.49984 | 0.06400 | 4.3900 | 4.6460 | 3.00 | 5.00 |

As can be seen from the Table 39, each group has high intention to use AR since their responses are much higher than the average value (3.00). In addition, the difference among the groups is very small. However, for concluding hypothesis 5, it is necessary to investigate whether the sample is suitable for ANOVA test and whether the difference is significant.

Table 40 shows the test results for homogeneity of variances. According to the results, the homogeneity of sample was verified with significance value of 0.558 which is expected to be higher than 0.05. As a result, the sample is suitable for applying ANOVA test.

Table 40. Test of Homogeneity of Variances for H5

| AvgIntToUseAr | | | |
|---|---|---|---|
| Levene Statistic | df1 | df2 | Sig. |
| 0.696 | 3 | 57 | 0.558 |

Table 41 illustrates the results of ANOVA test for H5. According to table, significance value is not less than 0.05 ($F$=0.369, $p$=0.775), and thus there is not a significant difference between the education levels with respect to AR usage intention. In conclusion, hypothesis 5 is not supported.

Table 41. ANOVA Analysis for H5

| AvgIntToUseAr | | | | | |
|---|---|---|---|---|---|
| | Sum of Squares | df | Mean Square | F | Sig. |
| Between Groups | 0.286 | 3 | 0.095 | 0.369 | 0.775 |
| Within Groups | 14.704 | 57 | 0.258 | | |
| Total | 14.990 | 60 | | | |

## 5.7 Independent samples t-test analysis results

For figuring out the position, gender and age effect on intention to use AR; hypothesis 6, hypothesis 7 and hypothesis 8 were tested by using independent samples t-test and the results will be given in this part.

### 5.7.1 Hypothesis 6

Respondents were grouped according to their positions as educational specialist, assistant educational specialist, office assistant and internal trainer. However, there was a problem with the distribution of 61 respondents on these positions as follows: 17 educational specialists, 3 assistant educational specialists, 3 office assistants and 38 internal trainers. Therefore, there was a need for recoding the position variable. According to the new classification, first group covered the training department workers which were educational specialist, assistant educational specialist, and office assistant while second group included only internal trainers which were actually subject matter experts and working on different departments.

After that, to test hypothesis 6 (H6) “There is a significant difference on AR Usage Intention between the positions”, independent samples t-test was conducted to explore whether there was a significant difference between these two groups with respect to their AR usage intention.

Table 42 shows the mean values of positions with respect to their AR usage intention. As can be seen from the table, both groups have very high intention to use AR since their responses are much higher than the average value (3.00). Although the difference between the groups is very small, training department workers have a slightly higher intention use AR than internal trainers. However, for concluding hypothesis 6, it is necessary to investigate the significance value.

Table 42. Group Statistics for H6

| | Position_ recoded | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| AvgIntToUseAr | 1 | 23 | 4.5304 | 0.44152 | 0.09206 |
| | 2 | 38 | 4.5105 | 0.53766 | 0.08722 |

Table 43 illustrates the results of independent samples t-test for H6. According to Levene's Test, the assumption of Equal Variances holds, and significance value is much higher than 0.05 ($t$=0.150 and $p$=0.882). Therefore, it can be concluded that while training department workers have a slightly higher intention use AR than internal trainers, there is not a significant difference on AR Usage Intention between training department workers and internal trainers. In conclusion, hypothesis 6 is not supported.

Table 43. Independent Samples Test for H6

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| AvgIntToUseAr | Equal variances assumed | 0.963 | 0.330 | 0.150 | 59 | 0.882 | 0.01991 | 0.13314 | -0.24650 | 0.28632 |
| | Equal variances not assumed | | | 0.157 | 53.56 | 0.876 | 0.01991 | 0.12682 | -0.23440 | 0.27421 |

5.7.2 Hypothesis 7

Respondents were grouped according to their gender as female and male. To test hypothesis 7 (H7) “There is a significant difference on AR Usage Intention between males and females”, independent samples t-test was conducted.

Table 44 shows the mean values of genders with respect to their AR usage intention. As can be seen from the table, both groups have very high intention to use AR since their responses are much higher than the average value (3.00). Although the difference between the groups is very small, males have a slightly higher intention use AR than females. However, for concluding hypothesis 7, it is necessary to investigate the significance value.

Table 44. Group Statistics for H7

| | Gender | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| AvgIntToUseAr | 1 | 35 | 4.4171 | 0.54096 | 0.09144 |
| | 2 | 26 | 4.6538 | 0.41010 | 0.08043 |

Table 45 illustrates the results of independent samples t-test for H7.

Table 45. Independent Samples Test for H7

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| AvgIntToUseAr | Equal variances assumed | 3.317 | 0.074 | -1.867 | 59 | 0.067 | -0.23670 | 0.12681 | -0.49045 | 0.01705 |
| | Equal variances not assumed | | | -1.944 | 58.962 | 0.057 | -0.23670 | 0.12178 | -0.48038 | 0.00698 |

According to Levene's Test, the assumption of Equal Variances holds, and significance value is higher than 0.05 ($t$=-1.867 and $p$=0.067), so it is acceptable in 10% alpha level. Therefore, it can be concluded that there is a significant difference on AR Usage Intention between males and females. In addition, males have a slightly higher intention to use AR than females. In conclusion, hypothesis 7 is supported in 10% alpha level.

### 5.7.3 Hypothesis 8

Respondents were grouped according to their age groups as equal and less than 32 and more than 32. To test hypothesis 8 (H8) “There is a significant difference on AR Usage Intention between the age groups”, independent samples t-test was conducted.

Table 46 shows the mean values of age groups with respect to their AR usage intention. As can be seen from the table, both groups have very high intention to use AR since their responses are much higher than the average value (3.00). In addition, the difference between the groups is so small. However, for concluding hypothesis 8, it is necessary to investigate the significance value.

Table 46. Group Statistics for H8

| | Age | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| AvgIntToUseAr | 1 | 30 | 4.5267 | 0.51323 | 0.09370 |
| | 2 | 31 | 4.5097 | 0.49488 | 0.08888 |

Table 47 illustrates the results of independent samples t-test for H8. According to Levene's Test, the assumption of Equal Variances holds, and significance value is higher than 0.05 ($t$=0.132 and $p$=0.896), so it is not acceptable in 5% alpha level. In addition, it is not acceptable in 10% alpha level. Therefore, it can be concluded that there is not a significant difference on AR Usage Intention between age groups and hypothesis 8 is not supported.

Table 47. Independent Samples Test for H8

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | 95% Confidence Interval of the Difference | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| AvgIntToUseAr | Equal variances assumed | 0.003 | 0.955 | 0.132 | 59 | 0.896 | 0.01699 | 0.12907 | -0.24129 | 0.27526 |
| | Equal variances not assumed | | | 0.132 | 58.715 | 0.896 | 0.01699 | 0.12915 | -0.24147 | 0.27545 |

## 5.8 Responses to open-ended questions

In the evaluation survey, there are four open ended questions that were answered by most of the participants voluntarily. In this part, the given answers will be introduced. Turkish answers for these four questions are attached in Appendix H.

### 5.8.1 First question

The first question was “If I needed to write three words about Augmented Reality ...”. There were 42 valid answers and the summary of given answers is presented as follows in Table 48.

11 participants have written active learning and retention. In addition, 10 participants have felt inside AR application. Seven participants have been excited and motivated. Six of them have synchronized Virtual Reality with AR. Five of them have found AR different and innovative. Other important words related with AR were fascinating, useful, important, clear, easy training, interactive, revolution, timesaving, immature, Augmented Reality, Aurasma, Blippar, Google Glass, cloud computing and 3D printer.

In conclusion, participants have been highly impressed with AR features and they have been convinced that AR usage in education could provide important benefits.

Table 48. The Summary of Given Answers for First Open-Ended Question

| If I needed to write 3 words about Augmented Reality … | Total | Frequency |
|---|---|---|
| Active learning and retention | 11 | 26% |
| Future, new technologies | 10 | 23% |
| Feeling inside, experience | 10 | 23% |
| Inspiration, curiosity, excitement | 7 | 16% |
| Fun, pleasure, motivation | 7 | 16% |
| Virtual reality | 6 | 14% |
| Different, innovative, creativity | 5 | 12% |
| Imagination | 5 | 12% |
| Visualization | 3 | 7% |
| Fascination, impressive, fascinating | 3 | 7% |
| Useful | 3 | 7% |
| Important | 2 | 5% |
| Clear | 2 | 5% |
| Easy training | 2 | 5% |
| Interactive | 1 | 2% |
| Revolution | 1 | 2% |
| Timesaving | 1 | 2% |
| Immature | 1 | 2% |
| Augmented Reality | 1 | 2% |
| Aurasma, Blippar, Google Glass | 1 | 2% |
| Cloud computing, 3D printer | 1 | 2% |

### 5.8.2 Second question

The second question was “If I would like to see AR as something ...”. There were 34 valid answers and the summary of given answers is as follows in Table 49.

As can be investigated from the table, participants have seen AR as an unreal, untouchable, supernatural concept and most of them have given answers like dream, science fiction movie, ghost, magic wand, a window to a secret garden and time machine. Some others have viewed AR as a funny object like aquarium, snow globe, flexible colorful rope and simulation. In addition, some participants have given as answers; world tour and brain. In conclusion, all answers included fun, colorfulness, novelty and a piece of surprise.

Table 49. The Summary of Given Answers for Second Open-Ended Question

| If I would like to see AR as something … | Total | Frequency |
|---|---|---|
| Dream | 8 | 24% |
| Science fiction movie | 5 | 15% |
| Ghost | 2 | 6% |
| Magic wand, magic | 2 | 6% |
| Aquarium | 2 | 6% |
| A window to a secret garden | 2 | 6% |
| Simulation | 2 | 6% |
| Life | 1 | 3% |
| Time Machine | 1 | 3% |
| Teleport | 1 | 3% |
| Snow globe | 1 | 3% |
| Flexible colorful rope | 1 | 3% |
| Brain | 1 | 3% |
| World tour | 1 | 3% |
| Game console | 1 | 3% |

### 5.8.3 Third question

The third question was “I like this experience because ...”. There were 39 valid answers and the summary of given answers is as follows in Table 50. Answers to this question were similar to the first question.

10 participants have defined that AR facilitated learning and it made the trainings more enjoyable. Nine participants have found AR as a different experience. In addition, eight participants have seen AR as a funny environment. Four of the participants have called AR amazing while two of them have called AR as interesting. The other answers have emphasized that AR provided creativity, novelty and futuristic feelings and thoughts.

In summary, more than half of the participants have liked AR environments and have found beneficial for educational usage looking from different perspectives.

Table 50. The Summary of Given Answers for Third Open-Ended Question

| I like this experience because ... | Total | Frequency |
|---|---|---|
| It facilitated learning, it was reminiscent, it was educative / instructive, it made the trainings more enjoyable | 10 | 26% |
| It was a different experience | 9 | 23% |
| It was fun | 8 | 21% |
| It was amazing / it was fascinating / it was exciting | 4 | 10% |
| It was interesting | 2 | 5% |
| It developed my imagination / strengthened my creativity | 2 | 5% |
| It provided me to think differently | 2 | 5% |
| I like trying new things | 2 | 5% |
| It made me feel belong to technology age | 2 | 5% |
| I can use it both in training and at work | 2 | 5% |
| It was nested with reality | 1 | 3% |
| It made me feel inside real the environment, and this made me think that I could make more realistic decisions | 1 | 3% |
| It gave an idea about the future | 1 | 3% |
| I think that it will enter our life very soon | 1 | 3% |

### 5.8.4 Fourth question

The fourth question was “I am tough during this experience because ...”. There were 24 valid answers and the summary of given answers is as follows in Table 51.

According to results, due to being away from technology and experiencing AR for the first time, seven participants have been forced during AR experience. Two of the participants have said they experienced technical problems related with their phone. Other seven participants have defined they were not forced and they even liked it. Apart from them, the other answers were more related with cardboard VR experience. As a result, most of the participants did not face with any problem during AR experience.

Table 51. The Summary of Given Answers for Fourth Open-Ended Question

| I am tough during this experience because … | Total | Frequency |
|---|---|---|
| I experienced it for the first time | 7 | 29% |
| I was not forced, I liked it | 7 | 29% |
| I was forced because of being away from technology | 2 | 8% |
| It was difficult to use the cardboard | 2 | 8% |
| I experienced technical problems related with my phone | 2 | 8% |
| It was difficult to accept and adopt to technology | 1 | 4% |
| I think about how to use it in trainings | 1 | 4% |
| Cardboard / glasses could be more professional | 1 | 4% |
| My eyes were painful in cardboard | 1 | 4% |
| I got dizzy | 1 | 4% |
| Cardboard caused nausea | 1 | 4% |
| It forced my imagination | 1 | 4% |

## 5.9 Summary of the interview responses

During interviews, a semi-structured interview form was used. The form included six questions under three parts as follows:

- Part 1: AR features/benefits
- Part 2: AR limitations/suggestions
- Part 3: AR usage in education

Participation to interview was a voluntary activity and there were 10 people, two of them were male while eight of them were female. After each training group, the interviews were planned, and data was collected through these meetings. In this part, the given answers will be introduced. Turkish answers are attached in Appendix I.

### 5.9.1 First question

The first question was “Are there any features of AR technology that you liked? If so, what?” and the given answers are as follows:

- Feeling like in the same environment: When participants have interacted with AR application, they experienced many different situations like touching dinosaurs, discovering galaxies, investigating human body and organs etc. During these experiences, they have felt that they were in these environments. As an example, they have felt that they were in ancient ages and dinosaurs were around them. This situation was called as "feeling like in the same environment" by some participants.
    - Four of the participants have said that audio and visual support of AR environments made them feel as if they were in the same environment.
    - The other two participants have defined that interacting with situations and concepts that they would not be able to access under normal conditions made them feel like they were in the same environment.
    - Six of the participants have indicated that this situation provided them to learn new things without having awareness.
- One participant has stated that he learned unwittingly by wondering.
- One participant has said he was excited about such different environments and he found these environments interesting. He has predicted that AR would attract attention of his students.
- One participant has said she felt like having supernatural or superpowers.

- One participant has stated he had fun in this experience.
- One participant has said he could do creative work.
- One participant has said AR would be an important step in digital transformation and he has defined he liked this idea.

5.9.2 Second question

The second question was “Do you think that there are any the advantages / benefits of AR?” and the given answers were as follows:

- Impact aspect
    - While three participants have indicated it was fun, two participants have emphasized it was engaging and motivating.
    - Two other participants have stated that AR examples were easily accessible.
    - One participant has stated that she experienced reality and virtuality at the same time together.
- Learning aspect
    - Two participants have indicated that it was an appropriate method for satisfying the expectations of the new generation.
    - Two participants have mentioned that visualizing concepts made learning easier, while two participants indicated that embodying abstract concepts facilitated the learning process.
    - One participant has pointed out that AR has contributed to learning by living and experiencing. In addition, three participants have stated AR was more instructive as well as more enjoyable experience. As a result, remembering just learned items was easier.

- Usage areas
    - Some of the participants have pointed out the possible areas where AR could be useful. Three people have stated that the printed materials would be more interesting with AR support, and by the way, these materials could be updated more easily. One person has stated that AR-supported posters would also attract more attention. One person has defined AR could make e-learning more interactive. One another person has pointed out participants would be able to gain experience safely in risky applications with the help of an AR application. Three people have said that the number of field trips could decrease.
- Cost and time saving aspect
    - Three people have said AR could be able to contribute to cost and time-saving.

### 5.9.3 Third question

The third question was “Did you encounter any difficulties in using AR technology? If so, what are these?” and the given answers were as follows:

- While seven people have stated they had no problems during the AR experience, one person has defined he had a technical problem related with his phone (the phone was shut down).
- One person has stated she could not feel 3D experience very much.
- Another person has said she did not have any prior knowledge about AR and thus it was difficult to understand AR examples.

- Two people have stated they had a problem with cardboard while focusing on a point. On the other hand, the other person has said that when she used cardboard she felt like her freedom was limited. She has added that virtual experience might be dangerous since she could not see the real environment.
- One person has said she felt away from the technology and due to this feeling, she has indicated that she lost her courage for AR experience.

### 5.9.4 Fourth question

The fourth question was “Do you think that there are any disadvantages / limitations of AR?” and the given answers were as follows:

- Lack of technical knowledge aspect
    - Four participants have stated that they were excited about AR experience and they wanted to discover AR technology. However, they did not know the basic technical information about the AR. They have underlined that this was a big limitation for them.
- Psychological aspect
    - Looking from psychological aspect, some participants have wondered how the feelings of human beings would be affected. Furthermore, one participant had worried about the virtual effect on our interest in real life. Two participants have said that AR technology would limit our imagination and prevent our curiosity. Moreover, one participant has predicted that if the society is not ready for innovations in terms of knowledge and culture, new projects would fail.

- Physical hazards aspect
    - One participant has emphasized that breaking out of the environment in which the person was present might create dangerous consequences like PokemonGo example.
- Classroom management aspect
    - Two participants have expressed their concerns about classroom management. One of them has stated when they used AR in education, they would be required to teach AR technology to the students. They perceived this as an additional effort. Another participant has noted that he had some thoughts about how they would manage the class when some students could use AR successfully some other could not.
- Technological aspect
    - Two participants have emphasized the difficulty of installing the unknown programs, while another participant has indicated that navigation and usage features in the application should be easy.
- Financial limitations aspect
    - One participant has stressed about the financial issues, and two participants have emphasized that their students could not want to consume their internet package.

### 5.9.5 Fifth question

The fifth question was “What are your suggestions for the development of AR technology?” and the given answers were as follows:

- Suggestion for strategical positioning of AR
    - One participant said: "Since AR is a developing technology, there is a need for strategical positioning for AR. Nowadays, advertisement sector uses more AR technology since it is attractive for society. I think, it must be completely free, people should be able to easily access and use AR technology to develop day by day."
- Suggestions for AR application
    - Two participants have said that it would be nice if the application was platform and device independent and they could use the application in other areas of their life. For example, when people could use AR inside Instagram or Facebook application, it could become a widely known technology.
    - Two participants have said: "I wish I could learn about the details of the things that I confronted with while walking on the road with the help of an AR application, such as clothes, shoes, a bag or a car's brand. Or, I wish I could learn about the details of a dish in a restaurant such as in what conditions it was cooked."
    - One participant has said "If AR becomes easier to use, it may be a form of learning that the human brain can more easily perceive."
    - Two participants have said "It will be good if the downloaded data can be saved in application’s memory. The navigation aspect should be improved. When I open the application, AR should remember my last step, and it should take me to that point because I do not want to start from the beginning each time."

    - One participant has said: "If all AR used examples could be tagged by trainers and these examples could bring together in a pool, all trainers could access to a number of best practices."
- Suggestion for additional tool usage with AR
    - Three participants have said: "I wish, I had a more personalized experience with the help of some tools that help me feeling more senses. For example, it would be great, if I felt the taste or texture of the thing in AR experience."
    - One participant has said: "In VR experience, I wanted to try a headset providing me to hear voices closer like in the real environment."
- Suggestion for financial limitation
    - Two participants have said: "Technological opportunities should be developed. For instance, internet package is an important constraint, flexibility should be provided in this regard."

### 5.9.6 Sixth question

The sixth question was “Do you think that you can use AR technology in your trainings?” and the given answers were as follows:

- Recommendations for AR usage in behavioral development trainings from three participants are as follows:
    - "There may be some flashcards in Time Management training. Participants can use the phone camera to read the flashcard and they can reach detailed and animated information."

    - "For Successful Team training, Treasure Hunt game can be designed. In the game board, some cues and learning tips can be discovered via AR.”
    - "Values and strengths topics can be embodied in Leadership Coaching training."
- Recommendation for AR usage in orientation projects from one participant is as follows:
    - "During the orientation process, there could be an AR example for a new employee to learn about a person or processes of departments.”
- Recommendations for AR usage in Textile Retail vocational trainings from different participants are as follows:
    - One participant has given a suggestion for Capacity Training: "AR can be used to embody some abstract concepts like shelf and fixture."
    - Two participants have given suggestions for Range Training: "AR can be used to see the difference between a correctly combined store image and the wrong one. At the same time, in Range Planning training, participants can have the opportunity to observe consumers' simulated behaviors. In addition, AR can be used to make some instructions and procedures clearer in these processes."
    - One participant has stated an idea for Fabric Training: "AR can be used to understand the feel of fabrics in different textures."
    - Another participant has stated an idea for Fit Training: "The stage of wearing the product in rehearsal models can be animated in three dimensions via AR."

    - One participant has given an idea for Fashion History Training: "AR can provide for the participants to feel in a fashion show."
    - Another participant has also stated that new beginners to stitching techniques might experience a safe learning experience with this method.
- Recommendations for AR usage in field trips and shop visits from two participants were as follows:
    - "AR can be used in shop visits and field trips. For example, in fabric factories, there are various big machines. Investigating their working principle or their special parts may be harmful to inexperienced people. In these times, people can get the detailed information or procedures of these machines without touching the real machine via AR under safe conditions. Moreover, via AR supported store visits, participants can experience the features of different countries, cultures, weather, climate, and consumer behavior as well as time and cost savings."

### 5.9.7 Seventh question

The last question was “Do you want to add any idea or suggestion? If so, what is this?” and the given answer was as follows:

- Only one participant has said that she wanted to know how AR supported training content could be prepared at a basic level.

# CHAPTER 6

# CONCLUSION

## 6.1 Summary of the study

In today's rapidly changing world, trainers are required to develop themselves for using technology in their trainings because this is a requirement to reach the new generation's needs. Trainers should follow new trends, use them in their trainings and even provide support for their learners as they need (Prensky, 2001a, p.4; Bal & Bicen, 2016; Plumanns et al., 2016; Selwyn, Nemorin, & Johnson, 2017). AR is one of the novelties coming with technology. In recent years, studies have appeared about the benefits of AR usage in education. However, there are still very few studies in the literature on the use of AR in corporate trainings (Lee, 2012; Fonseca et al., 2014). Increasing the use of AR in corporate trainings depends on the training of internal trainers.

This study is carried out to investigate the awareness and attitudes of internal trainers about AR usage in education. Based on the given purpose, a training process was planned and applied with 61 participants from a corporate retail company in Turkey. Firstly, training materials and data collection tools were prepared. Then, trainings were announced to possible participants. After that, totally 61 participants came into the trainings. At the beginning of each training, an online awareness survey was applied to all participants. Then, trainings were given to increase the knowledge level of the participants. At the end of the trainings, an online evaluation survey was applied to all participants. Lastly, interviews were made with some of the voluntary participants which were only 10 people. Theoretical model is proposed based on Technology Acceptance Model.

The aim of the awareness survey was to examine some descriptive data and the prior knowledge about AR before the training. Awareness survey included 4 parts: demographic, technology usage, educational technology usage and knowledge level. Some questions were adopted from the literature while some others were generated by the researcher.

The training was planned as nearly 105 minutes and included some crucial information about AR technology which were compiled from the literature: technological change, definitions of AR and VR, AR and VR experience, AR history, AR types, AR usage areas, AR usage examples in training, AR benefits in training and AR development platforms.

The evaluation survey was conducted for evaluating the change of the participants' knowledge level about AR after the training and for understanding their tendency to use AR in their trainings. Evaluation survey included 6 parts: knowledge level, usability, AR features/advantages, AR attitude, intention to use, and AR view. Most of the questions were adopted from the literature while some others were generated by the researcher.

In line with thesis purpose, for testing hypotheses, the data coming from awareness survey and evaluation survey were used. Open ended questions and interview notes are also included in the study as follows:

- Hypothesis 1 which is “There will be an increase in the level of knowledge after classroom practice.” was tested by paired samples t-test for comparing the knowledge level of participants before and after the training session. The results showed that there is a significant increase in the level of knowledge after classroom practice and Hypothesis 1 is significantly supported.

- Hypothesis 2 which is “AR features have a positive effect on AR advantages.” was tested by simple linear regression analysis to investigate the relationship between AR features and AR advantages. The results showed that AR features explains 68.8% of the variation in AR advantages and hypothesis 2 is significantly supported.
- Hypothesis 3 which is “AR advantages, material/content usability and application usability have a positive effect on AR attitude.” was tested by multiple regression analysis. The results showed that AR advantages explains 69.3% of the variation in AR attitude while material/content usability explains 14.7% of the variation in AR attitude. According to the results, AR advantages has a strong positive effect on AR attitude, material/content usability has also an effect on AR attitude whereas application usability has no effect on AR Attitude. Another result is that AR advantages has higher effect than material/content usability on AR attitude. To sum up, hypothesis 3 is supported.
- Hypothesis 4 which is “AR advantages and AR attitude have a positive effect on AR usage intention” was tested by multiple regression analysis. The results showed that AR advantages explains 39.7% of the variation in AR usage intention while AR attitude explains 51.2% of the variation in AR usage intention. According to these results, AR advantages and AR attitude have a strong positive effect on AR usage intention. Another result is that AR attitude has higher effect than AR advantages on AR usage intention and hypothesis 4 is supported.

- Hypothesis 5 which is “There is a significant difference on AR Usage Intention between the education levels.” was tested by ANOVA and results showed that while all groups have high intention to use AR, there is not a significant difference between the education levels with respect to AR usage intention. In conclusion, hypothesis 5 is not supported.
- Hypothesis 6 which is “There is a significant difference on AR Usage Intention between the positions.” was tested by independent samples t-test. The results showed that while training department workers have a slightly higher intention use AR than internal trainers, there is not a significant difference on AR Usage Intention between training department workers and internal trainers. In conclusion, hypothesis 6 is not supported.
- Hypothesis 7 which is “There is an important difference on AR Usage Intention between males and females.” was tested by independent samples t-test. The results showed that males have a slightly higher intention use AR than females and there is a significant difference on AR Usage Intention between males and females. In conclusion, hypothesis 7 is supported in 10% alpha level.
- Hypothesis 8 which is “There is an important difference on AR Usage Intention between the age groups.” was tested by independent samples t-test. The results showed that both groups have very high intention to use AR but there is not a significant difference on AR Usage Intention between age groups. In conclusion, hypothesis 8 is not supported.

At the end of the evaluation survey, participants were asked four open-ended questions for learning their specific ideas about AR. According to the given answers, AR has been described with some interesting and surprising words: dream, science fiction movie, ghost, magic wand, a window to a secret garden, time machine, aquarium, snow globe, flexible colorful rope, world tour and brain.
These words could also show that participants have been highly impressed with AR experience, AR could facilitate learning and it could make the trainings more enjoyable. Participants have concluded that they did not face any problems during AR experience.

The intention of the interview was to collect shining ideas and specific views of participants about AR usage in education. Interviews including six questions were completed with participation of 10 people. The given responses related with AR features, advantages and limitations were consistent with prior studies.

AR features could be summarized as follows: feeling like in the same environment, audio and visual support, interaction with situations/concepts/people that were inaccessible under normal conditions, feeling like having superpowers, having fun, providing creativity.

The advantages of AR usage in education were as follows: satisfying the expectations of the new generation, visualizing abstract concepts, facilitating the learning process, updating information more easily, providing safer experience for risky applications, contributing to cost and time-saving.

Possible limitations for AR usage in education were as follows: trainers limited technical knowledge, issues related with classroom management, psychological effects of mixed reality technologies for participants, technological limitations and financial limitations. If financial costs to use AR are decreased by the related authorities and AR platforms are developed in terms of easy usage and fast access, it could be possible to overcome all these limitations and AR could be used in many different trainings such as behavioral development trainings, orientation trainings, Textile Retail vocational trainings, and field trips or shop visits.

To sum up, with the help of nearly two-hours training session on AR, almost all participants liked the whole AR experience and found it beneficial, funny, engaging, interacting, creative and motivating for educational use. Participants also have given answers showing that they perceived AR as a promising technology in digitalized age and they have intended to use AR in their trainings. Another finding of this study supporting the literature is that using AR in field trips and shop visits can provide people the experience of risky applications in safer conditions, and this can also contribute to cost and time-saving (Sommerauer & Muller, 2014). The other important finding which is similar to a prior study is that some participants want to know how AR supported training content can be prepared at a basic level (Santos et al., 2015). In conclusion, AR have attracted internal trainers to use AR in their trainings. As Lee (2012, p. 215) expressed “The future of AR looks bright.” and the future of AR usage in corporate trainings also looks bright.

## 6.2 Limitations and future suggestions

As Wojciechowski and Cellary (2013) mentioned AR technologies provide many advantages for training environments, AR could overwhelm the restrictions of traditional learning environment, and thus creating development opportunity for internal trainers about AR usage in education is a crucial need. This study suggests a way to reach that purpose. However, since this is a case study which is applied in a highly dynamic textile retail organization, there are some limitations that can be seen as recommendations for further research:

- Since this case study was applied in a textile retail organization, the results were completely affected from the company and its sector dynamics. In further studies, if this case study is applied in different companies from different sectors like health, manufacturing or automotive, the results might be generalized.
- Participation to the trainings was voluntary. For this reason, people who are interested in technology and AR have participated. If it is obligatory in a further study, different opinions might arise.
- Control group was not planned due to institutional dynamics. As a result, it was not possible to examine the changing approaches by giving reading material about the AR to a control group instead of a training session. If a control group is planned in a further research, the effect of training session on AR usage intention might be observed.
- All internal trainers were also subject matter experts and most of them frequently traveled for work. As a result, scheduling sessions for all internal trainers, more than 100 people, to participate was not possible.

Due to this reason, although the maximum participation number was reached, sample size was limited and totally 61 people participated to study. For further studies, it can be recommended to increase the sample size with different research design and settings.

- The questionnaire items were mostly based on the literature. Within the scope, specified features and advantages of AR were examined. In further studies, the different advantages and features of the AR can be examined by adding new items to data collection tools. As an example, according to results of this study, application usability has no effect on AR Attitude. It can be recommended to add new items to the related part of questionnaire and investigate the relationship in different company and sectors.

While conducting this study, some important points that could be accepted as further recommendations have been observed. To consider in further research, these observations were as follows:

- The educational technology team at the institution was competent to prepare the AR material. For this reason, the institution expected internal trainers mainly to develop ideas about where to use AR rather than to develop AR materials. So, this study did not cover to teach trainers how AR material can be developed. However, internal trainers had a strong willingness to develop AR material. In further studies, the scope could be broader to cover both the development of AR material and the usage of these AR materials in classrooms by the internal trainers. The more specified recommendation includes a series of training sessions with internal trainers as follows:

    - The first session can be for sharing knowledge about AR like in this study.
    - The second session can be for developing an AR application or content which will be used in a specified training.
    - In the next step, trainers can use AR application in a specified training.
    - After that, in the third session trainers can share their actual experiences with their classmates.
- One of the most contributing results of this study is the usage examples suggested by internal trainers. However, the scope of this study did not include to follow whether these ideas could be applied or not. In subsequent studies, the scope can be expanded to observe whether the internal trainers could implement the ideas they have proposed.
    - If they could implement; which results will be obtained from the learner, trainer and learning aspects could be important outputs.
    - If they could not implement, which obstacles they faced with while applying AR in their trainings could be a significant consequence.
- In the interviews, participants have proposed important suggestions on the development of AR platforms to provide easier and more common usage by the society. This can be an important implication for further research.
- In the interview, from given answers, especially the ones related with cardboard are mainly focused on the psychological side of mixed reality technologies and this can be another important implication for further research.

APPENDIX A

TRAINING MATERIALS


Fig. A1 Announcement picture of training groups (iStock, 2016)


Fig. A2 Training presentation pictures (Introduction part) (iStock, 2016)


Fig. A3 Training presentation pictures (Filling the awareness survey) (iStock, 2016)

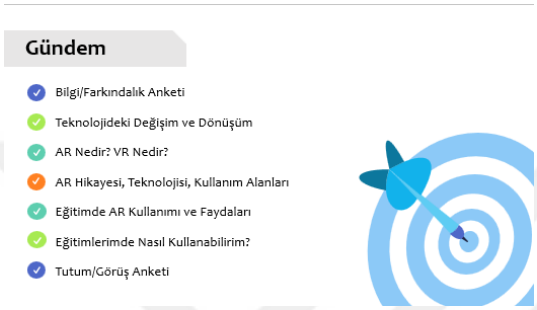


Fig. A4 Training presentation pictures (The agenda) (iStock, 2016)


Fig. A5 Training presentation pictures (The rapid change of technology)


Fig. A6 Training presentation pictures (2017 technology trends - 1) (iStock, 2016)


Fig. A7 Training presentation pictures (2017 technology trends - 2) (iStock, 2016)


Fig. A8 Training presentation pictures (2017 technology trends - 3) (iStock, 2016)


Fig. A9 Training presentation pictures (Future technology trends)


Fig. A10 Training presentation pictures (AR part) (iStock, 2016)


Fig. A11 Training presentation pictures (Real vs. virtual) (iStock, 2016)


Fig. A12 Training presentation pictures (AR definition) (iStock, 2016)


Fig. A13 Training presentation pictures (VR definition) (iStock, 2016)


Fig. A14 Training presentation pictures (AR experience) (iStock, 2016)

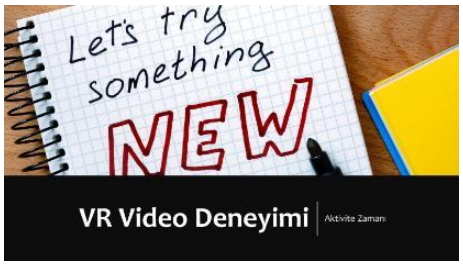


Fig. A15 Training presentation pictures (VR experience) (iStock, 2016)

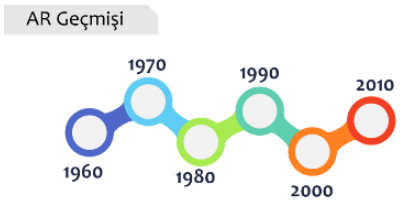


Fig. A16 Training presentation pictures (AR history) (iStock, 2016)


Fig. A17 Training presentation pictures (AR types) (iStock, 2016)


Fig. A18 Training presentation pictures (AR usage areas - 1) (iStock, 2016)


Fig. A19 Training presentation pictures (AR usage areas - 2) (iStock, 2016)


Fig. A20 Training presentation pictures (AR usage in education - 1) (iStock, 2016)


Fig. A21 Training presentation pictures (AR usage in education - 2)


Fig. A22 Training presentation pictures (AR usage in education - 3)

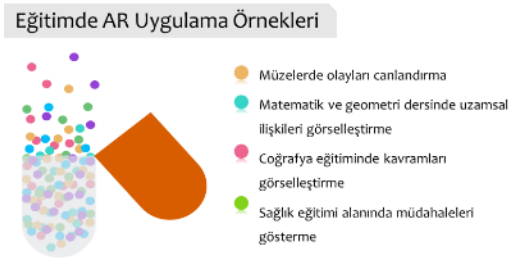


Fig. A23 Training presentation pictures (AR usage in education - 4)

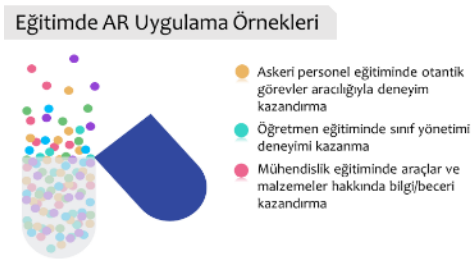


Fig. A24 Training presentation pictures (AR usage in education - 5)


Fig. A25 Training presentation pictures (AR usage in education - 6) (iStock, 2016)


Fig. A26 Training presentation pictures (AR usage in education - 1)


Fig. A27 Training presentation pictures (Filling the evaluation survey) (iStock, 2016)


Fig. A28 Sample screenshots from AR experience handouts (1)


Fig. A29 Sample screenshots from AR experience handouts (2)


Fig. A30 Sample screenshots from AR experience handouts (3)


Fig. A31 Sample screenshots from AR experience handouts (4)


Fig. A32 Sample screenshots from AR experience handouts (5)


Fig. A33 Sample screenshots from AR experience handouts (6)

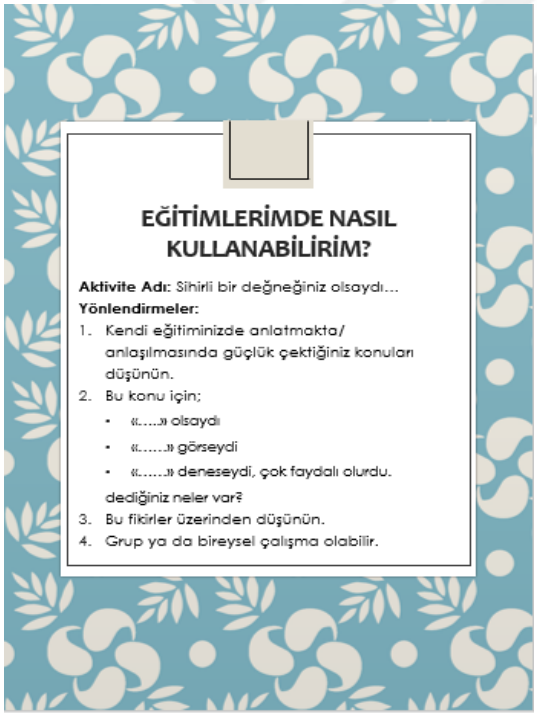


Fig. A34 Sample screenshots from brainstorming handouts (1)

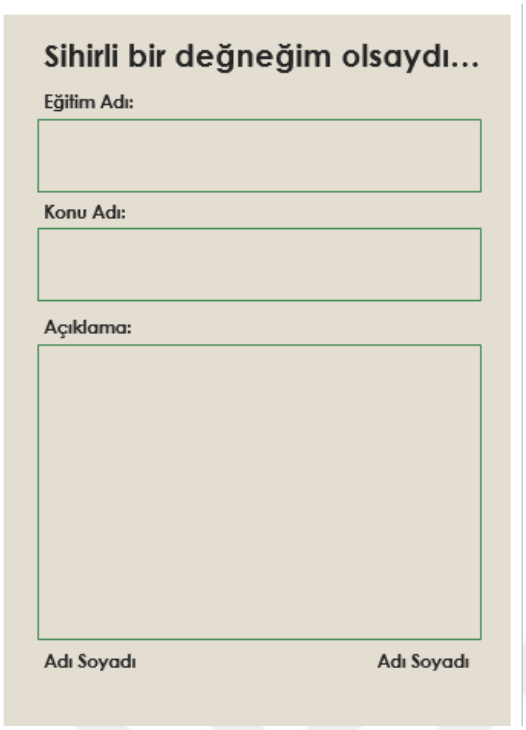


Fig. A35 Sample screenshots from brainstorming handouts (2)

Fig. A36 Photos taken during trainings while giving information (1)


Fig. A37 Photos taken during trainings while giving information (2)

Fig. A38  Photos taken during trainings while experiencing AR (1)

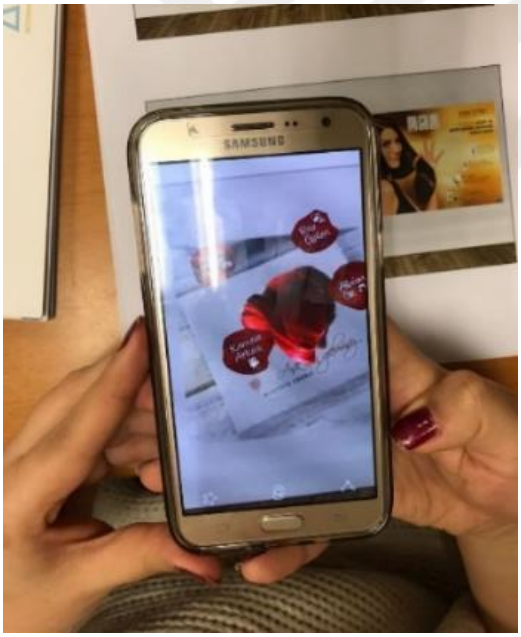


Fig. A39  Photos taken during trainings while experiencing AR (2)


Fig. A40  Photos taken during trainings while experiencing AR (3)

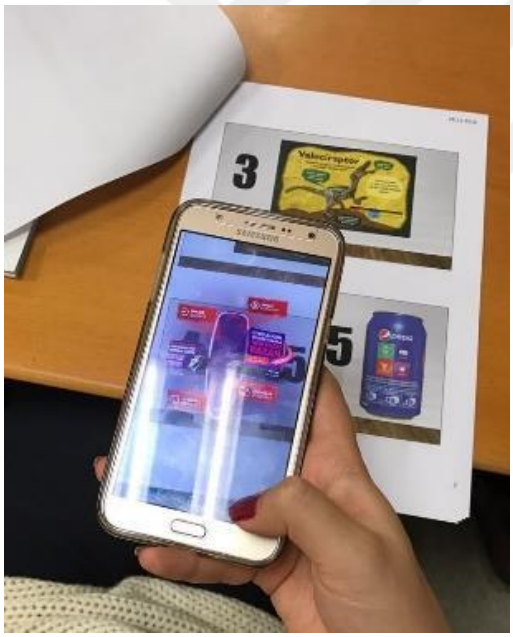


Fig. A41  Photos taken during trainings while experiencing AR (4)

Fig. A42  Photos taken during trainings while experiencing cardboard (1)

Fig. A43  Photos taken during trainings while experiencing cardboard (2)

Fig. A44  Photos taken during trainings while experiencing cardboard (3)

Fig. A45  Photos taken during trainings while experiencing cardboard (4)

APPENDIX B

AWARENESS SURVEY (ENGLISH)

Dear Colleagues,

The purpose of this questionnaire is to identify the awareness of the Internal Trainers and Educational Specialists about Augmented Reality.

Within the scope of the Graduate Thesis of Management Information Systems Department of Boğaziçi University; it is of great importance that you respond sincerely to the questions presented to you, in terms of scientific validity and reliability of the research. Please be sure that privacy of all your answers will be protected.

Thank you for your participation.

Nilay GÜNER

snilayerim@gmail.com

**PART 1: DEMOGRAPHIC INFORMATION**

1. Name Surname

*2. Gender

- Female
- Male

*3. Age

- 18-25
- 26-32
- 33-42
- 43 and more

*4. Education Level

- o High School
- o Undergraduate (2 years degree)
- o Undergraduate (4 years degree)
- o Graduate
- o Doctorate
- o Other (Please describe)

*5. Position

- o Educational Specialist
- o Assistant Educational Specialist
- o Internal Trainer
- o Other (Please describe)

**PART 2: TECHNOLOGY USAGE**

*6. Which devices do you use?

- □ Laptop
- □ Desktop
- □ Tablet
- □ Smart Phone
- □ Other (Please describe)

*7. Do you access to internet by which device mostly?

- o I have no access.
- o Laptop
- o Desktop
- o Tablet
- o Smart Phone
- o Other (Please describe)

*8. How many hours a day do you use the internet?

- o I have no use.
- o Less than 1 hour
- o 1-3 hour
- o 4-6 hour
- o 7-9 hour
- o 10 hour and more

*9. Choose the frequency of activities you are doing with internet.

| | Several times a month | Several times a week | Several times a day | 1-5 hours per day | More than 5 hours a day | I don't use |
|---|---|---|---|---|---|---|
| I do research. | | | | | | |
| I check my e-mails. | | | | | | |
| I follow news. | | | | | | |
| I update my blog. | | | | | | |
| I follow e-government procedures. | | | | | | |
| I visit social networking sites. (Facebook, twitter, etc.) | | | | | | |
| I do chat. | | | | | | |
| I do online shopping. | | | | | | |
| I listen / I watch music, video, etc. | | | | | | |
| I download file. | | | | | | |
| I play game. | | | | | | |

*10. Choose the frequency of virtual environments usage.

| | Several times a month | Several times a week | Several times a day | 1-5 hours per day | More than 5 hours a day | I don't use |
|---|---|---|---|---|---|---|
| Facebook | | | | | | |
| Twitter | | | | | | |
| Instagram | | | | | | |
| Pinterest | | | | | | |
| WhatsApp | | | | | | |
| E-mail | | | | | | |
| YouTube | | | | | | |
| Blogs/Wiki's | | | | | | |
| Game sites | | | | | | |

**PART 3: ATTITUDE TOWARDS TECHNOLOGY USAGE IN EDUCATION**

*11. Choose your views on the use of Technology in Education.

| | Strongly Disagree | Disagree | Not Sure | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I find the technology usage in education to be beneficial. | | | | | |
| I am not open to development about the innovations in Education Technologies. | | | | | |
| I am eager to learn about Trends in Education Technologies. | | | | | |
| I am curious to apply innovations in Education Technologies. | | | | | |
| I find the use of technology in education to be insignificant. | | | | | |
| I have enough knowledge about the Augmented Reality. | | | | | |
| I would like to learn new information about Augmented Reality. | | | | | |
| I would like to make practices for Augmented Reality. | | | | | |

**PART 4: KNOWLEDGE QUESTIONS**

*12. Which of the following is not among the strategic technology trends of 2017 announced by Gartner, a consulting firm that conducts independent research in the field of technology?

- Wearable Technology
- Social Media Profiles (correct option)
- Internet of Things
- 3D Printers
- Augmented Reality

*13. Which of the following could be the concept of Augmented Reality in English?

- Augmented Reality (correct option)
- Architectural Reality
- Augmented Virtuality
- Virtual Reality
- Virtual Continuum

*14. Which of the following is not an Augmented Reality feature?

- Contains virtual objects added to the real environment.
- It allows to see real environment and virtual objects simultaneously.
- It offers a 3D view.
- Google Glass is one of the known examples.
- There are some examples where the real environment is not used. (correct option)

*15. Which of the following is not the benefit provided by the use of Augmented Reality in education?

- Attracting the attention of the learner and increasing the motivation of them
- Developing critical thinking and problem solving skills
- Reducing costs in a significant manner (correct option)
- Ensuring that subjects and concepts that contain danger are learned in a trust environment
- Visualizing topics to make them easier to understand

*16. Which of the following is one of the platforms on which Augmented Reality material can be developed?

- PowerPoint
- Aurasma (correct option)
- Pinterest
- Go Animate
- Prezi

APPENDIX C

AWARENESS SURVEY (TURKISH)

Değerli Çalışma Arkadaşlarım,

Bu anketin amacı, Eğitim departmanı çalışanlarının ve İç Eğitmenlerin Artırılmış Gerçeklik konusunda farkındalıklarını tespit etmektir.

Boğaziçi Üniversitesi Yönetim Bilişim Sistemleri Bölümü Yüksek Lisans Tezi kapsamında yaptığım çalışmada; sizlere sunulan sorulara içtenlikle yanıt vermeniz, araştırmanın bilimsel geçerliliği ve güvenilirliği açısından büyük önem taşımaktadır. Tüm yanıtlarınızın gizliliği korunacaktır.

Zaman ayırarak çalışmama katıldığınız için teşekkür ederim.

Nilay GÜNER

snilayerim@gmail.com

**1. BÖLÜM: DEMOGRAFİK BİLGİLER**

1. Adınız Soyadınız

*2. Cinsiyetiniz

- Kadın
- Erkek

*3. Yaş Grubunuz

- 18-25
- 26-32
- 33-42
- 43 ve üzeri

*4. Eğitim Durumunuz

- o Ön Lisans
- o Lisans
- o Yüksek Lisans
- o Doktora
- o Other (Please decribe)

*5. Unvanınız

- o Eğitim Uzmanı
- o Eğitim Uzman Yardımcısı
- o İç Eğitmen
- o Other (Please decribe)

**2. BÖLÜM: TEKNOLOJİ KULLANIM DURUMU**

*6. Hangi cihazları kullanıyorsunuz?

- □ Dizüstü bilgisayar (Notebook, netbook gibi)
- □ Masaüstü bilgisayar
- □ Tablet
- □ Akıllı Telefon
- □ Other (Please decribe)

*7. İnternet'e en çok hangi cihaz üzerinden erişiyorsunuz?

- o Erişimim yok
- o Dizüstü bilgisayar (Notebook, netbook gibi)
- o Masaüstü bilgisayar
- o Tablet
- o Akıllı Telefon
- o Other (Please decribe)

*8. Günde kaç saat internet kullanıyorsunuz?

- o Hiç kullanmıyorum
- o 1 saatten az
- o 1-3 saat
- o 4-6 saat
- o 7-9 saat
- o 10 saat ve üzeri

*9. İnternet kullanma amacınızı ve ne sıklıkta kullandığınızı belirtin.

| | Ayda birkaç kez | Haftada birkaç kez | Günde birkaç kez | Günde 1-5 saat | Günde 5+ saat | Kullanmıyorum |
|---|---|---|---|---|---|---|
| Araştırma yaparım. | | | | | | |
| E-postalarımı kontrol ederim. | | | | | | |
| Güncel olayları/durumları takip ederim. | | | | | | |
| Kişisel web sayfamı/bloğumu düzenlerim. | | | | | | |
| E-devlet işlemlerini yaparım/takip ederim. | | | | | | |
| Sosyal paylaşım sitelerini ziyaret ederim. (facebook, twitter, vb.) | | | | | | |
| Sohbet ederim. | | | | | | |
| Alışveriş yaparım. | | | | | | |
| Müzik, video, vb. dinlerim/izlerim. | | | | | | |
| Dosya indiririm. | | | | | | |
| Oyun oynarım. | | | | | | |

*10. Kullandığınız sanal ortamları ve kullanma sıklığınızı işaretleyin.

| | Ayda birkaç kez | Haftada birkaç kez | Günde birkaç kez | Günde 1-5 saat | Günde 5+ saat | Kullanmıyorum |
|---|---|---|---|---|---|---|
| Facebook | | | | | | |
| Twitter | | | | | | |
| Instagram | | | | | | |
| Pinterest | | | | | | |
| Whatsapp | | | | | | |
| E-posta | | | | | | |
| Youtube | | | | | | |
| Blog/Wiki/Sözlük | | | | | | |
| Oyun siteleri | | | | | | |

## 3. BÖLÜM: EĞİTİMDE TEKNOLOJİ KULLANIMINA YÖNELİK YAKLAŞIM

*11. Eğitimde Teknoloji kullanımı konusunda görüşlerinizi belirtiniz.

| | Kesinlikle Katılmıyorum | Katılmıyorum | Emin Değilim | Katılıyorum | Kesinlikle Katılıyorum |
|---|---|---|---|---|---|
| Teknolojinin eğitimde kullanılmasını faydalı bulurum. | | | | | |
| Eğitim Teknolojilerindeki yenilikler ile ilgili gelişmeye açığım. | | | | | |
| Eğitim Teknolojileri trendleri hakkında öğrenmeye istekliyim. | | | | | |
| Eğitim Teknolojileri yeniliklerini uygulamaya meraklıyım. | | | | | |
| Eğitimde Teknoloji kullanımını önemsiz buluyorum. | | | | | |
| Artırılmış Gerçeklik teknolojisi konusunda yeterli bilgiye sahibim. | | | | | |
| Artırılmış Gerçeklik teknolojisi ile ilgili yeni bilgiler öğrenmek isterim. | | | | | |
| Artırılmış Gerçeklik teknolojisi ile ilgili uygulamalar yapmak isterim. | | | | | |

## 4. BÖLÜM: BİLGİ SORULARI

*12. Aşağıdakilerden hangisi Teknoloji alanında bağımsız araştırmalar yapan danışmanlık şirketi Gartner tarafından açıklanan 2017 yılının stratejik teknoloji trendleri arasında bulunmamaktadır?

- Giyilebilir Teknoloji
- Sosyal Medya Profilleri (doğru cevap)
- Nesnelerin İnterneti
- 3D Yazıcılar
- Artırılmış Gerçeklik

*13. Aşağıdakilerden hangisi Artırılmış Gerçeklik kavramının İngilizce karşılığı olabilir?

- Augmented Reality (doğru cevap)
- Architecturel Reality
- Augmented Virtuality
- Virtual Reality
- Virtual Continuum

*14. Aşağıdakilerden hangisi Artırılmış Gerçeklik özelliği değildir?

- Gerçek çevreye eklenmiş sanal objeleri içerir.
- Gerçek çevreyi ve sanal objeleri eş zamanlı olarak görme imkanı verir.
- 3 boyutlu görünüm sunar.
- Google Glass bilinen örneklerden biridir.
- Gerçek ortamın kullanılmadığı örnekler mevcuttur. (doğru cevap)

*15. Aşağıdakilerden hangisi Artırılmış Gerçekliğin eğitimde kullanımının sağladığı faydalardan değildir?

- Öğrencinin dikkatini çekme ve öğrencinin motivasyonunu artırma
- Eleştirel düşünme ve problem çözme becerilerini geliştirme
- Maliyetleri önemli ölçüde azaltma (doğru cevap)
- Tehlike içeren konu ve kavramların güven ortamında öğrenilmesini sağlama
- Konuları görselleştirerek daha kolay anlaşılmasını sağlama

*16. Aşağıdakilerden hangisi Artırılmış Gerçeklik materyali geliştirilebilen platformlardan biridir?

- Powerpoint
- Aurasma (doğru cevap)
- Pinterest
- GoAnimate
- Prez

APPENDIX D

EVALUATION SURVEY (ENGLISH)

Dear Colleagues,

The purpose of this questionnaire is to see the increase in awareness of the Internal Trainers and Educational Specialists about Augmented Reality and to learn their views on the subject.

Within the scope of the Graduate Thesis of Management Information Systems Department of Boğaziçi University; it is of great importance that you respond sincerely to the questions presented to you, in terms of scientific validity and reliability of the research. Please be sure that privacy of all your answers will be protected.

Thank you for your participation.

Nilay GÜNER

snilayerim@gmail.com

*1. Name Surname

**PART 1: KNOWLEDGE QUESTIONS**

In order to see the contribution of the training session, it is very valuable to answer the questions in the first questionnaire.

*2. Which of the following is not among the strategic technology trends of 2017 announced by Gartner, a consulting firm that conducts independent research in the field of technology?

- Wearable Technology
- Social Media Profiles (correct option)
- Internet of Things
- 3D Printers
- Augmented Reality

*3. Which of the following could be the concept of Augmented Reality in English?

- Augmented Reality (correct option)
- Architecturel Reality
- Augmented Virtuality
- Virtual Reality
- Virtual Continuum

*4. Which of the following is not an Augmented Reality feature?

- Contains virtual objects added to the real environment.
- It allows to see real environment and virtual objects simultaneously.
- It offers a 3D view.
- Google Glass is one of the known examples.
- There are some examples where the real environment is not used. (correct option)

*5. Which of the following is not the benefit provided by the use of Augmented Reality in education?

- Attracting the attention of the learner and increasing the motivation of them
- Developing critical thinking and problem solving skills
- Reducing costs in a significant manner (correct option)
- Ensuring that subjects and concepts that contain danger are learned in a trust environment
- Visualizing topics to make them easier to understand

*6. Which of the following is one of the platforms on which Augmented Reality material can be developed?

- Powerpoint
- Aurasma (correct option)
- Pinterest
- Go Animate
- Prezi

**PART 2: USABILITY ITEMS**

*7. Evaluate the expressions about the materials and content used.

| | Strongly Disagree | Disagree | Not Sure | Agree | Strongly Agree |
|---|---|---|---|---|---|
| The materials used made it easier to understand. | | | | | |
| The structure of the sessions/exercises made it easy to understand. | | | | | |
| I could easily get the idea through the application I made. | | | | | |
| The information provided was satisfactory. | | | | | |
| Time was used effectively. | | | | | |

*8. Evaluate the expressions about Augmented Reality and Virtual Reality applications.

| | Strongly Disagree | Disagree | Not Sure | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I used the Augmented Reality (AR) application with ease. | | | | | |
| I did not have a technical problem when using AR. | | | | | |
| I was pleased with the AR experience. | | | | | |
| I could easily use the Virtual Reality cardboard. | | | | | |
| I did not have a technical problem during the Virtual Reality experience. | | | | | |
| I liked the Virtual Reality experience. | | | | | |

**PART 3: AUGMENTED REALITY FEATURES/ADVANTAGES**

*9. Evaluate the items about the features of the Augmented Reality.

| | Strongly Disagree | Disagree | Not Sure | Agree | Strongly Agree |
|---|---|---|---|---|---|
| 3D animations made me feel close to real life. | | | | | |
| 3D animations provided me to show more interest to the subject. | | | | | |
| I feel impressed from the usage of 3D animations. | | | | | |
| I would like to share my AR learning experience with my environment. | | | | | |
| Learning with AR can enhance teacher–learner interaction. | | | | | |
| Learning with AR can enhance learner–learner interaction. | | | | | |
| AR moved my imagination into action. | | | | | |
| AR encouraged me to think creatively. | | | | | |

*10. Evaluate the items about the advantages of Augmented Reality.

| | Strongly Disagree | Disagree | Not Sure | Agree | Strongly Agree |
|---|---|---|---|---|---|
| AR made learning content fun. | | | | | |
| AR examples increased my learning desire. | | | | | |
| AR made me motivated to learn new information. | | | | | |
| I can find solutions to the problems that I encounter in learning environments with AR technology. | | | | | |
| AR showed me that I could find solutions in different ways. | | | | | |
| AR have contributed my problem solving skills. | | | | | |
| When I encountered the problem, I was able to ask questions to trainer easily. | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| AR provided me the opportunity to interact with the participants. | | | | | |
| AR provided me the experience that I want to share. | | | | | |

**PART 4: AR ATTITUDE**

*11. Evaluate the items about the attitude towards Augmented Reality.

| | Strongly Disagree | Disagree | Not Sure | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Using AR in a learning environment is an impressive idea. | | | | | |
| AR contributes to increase knowledge in education. | | | | | |
| AR is a learning tool that will make a difference in education. | | | | | |

**PART 5: INTENTION TO USE AR IN EDUCATION**

*12. Evaluate the items about using AR in the field of education.

| | Strongly Disagree | Disagree | Not Sure | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I think that the use of AR in education provides advantage. | | | | | |
| I would like to know more about AR. | | | | | |
| I would like to get more experience about AR. | | | | | |
| I would like to see AR technology in every training I participate. | | | | | |
| I want to use AR applications in my trainings. | | | | | |

**PART 6: AR VIEW QUESTIONS**

13. If I needed to write 3 words about Augmented Reality ...

14. If I would like to see AR as something ...

15. I like this experience because ...

16. I am tough during this experience because ...

APPENDIX E

EVALUATION SURVEY (TURKISH)

Değerli Çalışma Arkadaşlarım,

Bu anketin amacı, Eğitim departmanı çalışanlarının ve İç Eğitmenlerin Artırılmış Gerçeklik konusunda farkındalıklarındaki artışı görmek ve konu ile ilgili görüşlerini öğrenmektir.

Boğaziçi Üniversitesi Yönetim Bilişim Sistemleri Bölümü Yüksek Lisans Tezi kapsamında yaptığım çalışmada; sizlere sunulan sorulara içtenlikle yanıt vermeniz, araştırmanın bilimsel geçerliliği ve güvenilirliği açısından büyük önem taşımaktadır. Tüm yanıtlarınızın gizliliği korunacaktır.

Zaman ayırarak çalışmama katıldığınız için teşekkür ederim.

Nilay GÜNER

snilayerim@gmail.com

*1. Adınız Soyadınız

**1. BÖLÜM: BİLGİ SORULARI**

Bilgilendirme seansının katkısını görebilmek için ilk ankette yer alan bilgi sorularını yanıtlamanız çok kıymetlidir.

*2. Aşağıdakilerden hangisi 2017 yılının stratejik teknoloji trendleri arasında bulunmamaktadır?

- Giyilebilir Teknoloji
- Sosyal Medya Profilleri (doğru cevap)
- Nesnelerin İnterneti
- 3D Yazıcılar
- Artırılmış Gerçeklik

*3. Aşağıdakilerden hangisi Artırılmış Gerçeklik kavramının İngilizce karşılığı olabilir?

- Augmented Reality (doğru cevap)
- Architecturel Reality
- Augmented Virtuality
- Virtual Reality
- Virtual Continuum

*4. Aşağıdakilerden hangisi Artırılmış Gerçeklik özelliği değildir?

- Gerçek çevreye eklenmiş sanal objeleri içerir.
- Gerçek çevreyi ve sanal objeleri eş zamanlı olarak görme imkanı verir.
- 3 boyutlu görünüm sunar.
- Google Glass bilinen örneklerden biridir.
- Gerçek ortamın kullanılmadığı örnekler mevcuttur. (doğru cevap)

*5. Aşağıdakilerden hangisi Artırılmış Gerçekliğin eğitimde kullanımının sağladığı faydalardan değildir?

- Öğrencinin dikkatini çekme ve öğrencinin motivasyonunu artırma
- Eleştirel düşünme ve problem çözme becerilerini geliştirme
- Maliyetleri önemli ölçüde azaltma (doğru cevap)
- Tehlike içeren konu ve kavramların güven ortamında öğrenilmesini sağlama
- Konuları görselleştirerek daha kolay anlaşılmasını sağlama

*6. Aşağıdakilerden hangisi Artırılmış Gerçeklik materyali geliştirilebilen platformlardan biridir?

- Powerpoint
- Aurasma (doğru cevap)
- Pinterest
- GoAnimate
- Prezi

## 2. BÖLÜM: KULLANILABİLİRLİK SORULARI

*7. Kullanılan materyaller ve içerik ile ilgili verilen ifadeleri değerlendirin.

| | Kesinlikle Katılmıyorum | Katılmıyorum | Emin Değilim | Katılıyorum | Kesinlikle Katılıyorum |
|---|---|---|---|---|---|
| Kullanılan materyaller konuyu anlamamı kolaylaştırdı. | | | | | |
| İçeriğin akışı konuyu kolaylıkla anlamamı sağladı. | | | | | |
| Yaptığım uygulama sayesinde kolaylıkla fikir yürütebildim | | | | | |
| Verilen bilgiler tatmin edici düzeydeydi. | | | | | |
| Zaman etkin kullanıldı. | | | | | |

*8. Artırılmış Gerçeklik ve Sanal Gerçeklik uygulamaları ile ilgili verilen ifadeleri değerlendirin.

| | Kesinlikle Katılmıyorum | Katılmıyorum | Emin Değilim | Katılıyorum | Kesinlikle Katılıyorum |
|---|---|---|---|---|---|
| Artırılmış Gerçeklik (AG) uygulamasını kolaylıkla kullandım. | | | | | |
| AG uygulamasını kullanırken teknik bir sorun yaşamadım. | | | | | |
| AG deneyimi beni memnun etti. | | | | | |
| Sanal Gerçeklik gözlüğünü kolaylıkla kullanabildim. | | | | | |
| Sanal Gerçeklik deneyimi sırasında teknik bir sorun yaşamadım. | | | | | |
| Sanal Gerçeklik deneyimini sevdim. | | | | | |

## 3. BÖLÜM: ARTIRILMIŞ GERÇEKLİK ÖZELLİKLERİ/AVANTAJLARI

*9. Artırılmış Gerçekliğin özellikleri ile ilgili verilen ifadeleri değerlendirin.

| | Kesinlikle Katılmıyorum | Katılmıyorum | Emin Değilim | Katılıyorum | Kesinlikle Katılıyorum |
|---|---|---|---|---|---|
| 3 boyutlu animasyonlar, gerçek ortama yakın olduğumu hissettirdi. | | | | | |
| 3 boyutlu animasyonlar, konuya daha çok ilgi göstermemi sağladı. | | | | | |
| 3 boyutlu animasyonların kullanımından etkilendim. | | | | | |
| Artırılmış Gerçeklik ile öğrenme deneyimimi yakınlarımla paylaşmak isterim. | | | | | |
| AG, katılımcı ve eğitmen arasındaki etkileşime katkı sağladı. | | | | | |
| AG, katılımcılar arasındaki etkileşimi arttırdı. | | | | | |
| AG, hayal gücümü harekete geçirdi. | | | | | |
| AG, yaratıcı düşünmek için beni teşvik etti. | | | | | |

*10. Artırılmış Gerçekliğin avantajları ile ilgili verilen ifadeleri değerlendirin.

| | Kesinlikle Katılmıyorum | Katılmıyorum | Emin Değilim | Katılıyorum | Kesinlikle Katılıyorum |
|---|---|---|---|---|---|
| AG, eğitim içeriğini eğlenceli hale getirdi. | | | | | |
| AG uygulama örnekleri, öğrenme isteğimi artırdı. | | | | | |
| Yeni bilgiler öğrenmek için motive etti. | | | | | |
| AG uygulamaları ile öğrenme ortamlarında karşılaştığım problemlere çözüm bulabilirim. | | | | | |
| Farklı yollardan çözümler bulabileceğimi gösterdi. | | | | | |
| Problem çözme becerilerime katkıda bulundu. | | | | | |
| Problemle karşılaştığım anlarda eğitmene rahatlıkla soru sorabildim. | | | | | |
| AG uygulaması, katılımcılarla etkileşim kurma şansı sağladı. | | | | | |
| Paylaşmak isteyeceğim bir deneyim edinmemi sağladı. | | | | | |

## 4. BÖLÜM: ARTIRILMIŞ GERÇEKLİK KULLANIMINA YÖNELİK YAKLAŞIM

*11. Artırılmış Gerçekliğin eğitim alanında kullanımına yönelik yaklaşımınız ile ilgili verilen ifadeleri değerlendirin.

| | Kesinlikle Katılmıyorum | Katılmıyorum | Emin Değilim | Katılıyorum | Kesinlikle Katılıyorum |
|---|---|---|---|---|---|
| Öğrenme ortamında AG kullanmak etkileyici bir fikirdir. | | | | | |
| AG, eğitimde bilgi artışına katkı sağlar. | | | | | |
| AG, eğitimde fark yaratacak bir öğrenme aracıdır. | | | | | |

## 5. BÖLÜM: ARTIRILMIŞ GERÇEKLİĞİN EĞİTİMDE KULLANIMI

*12. Artırılmış Gerçekliğin eğitim alanında kullanımı ile ilgili verilen ifadeleri değerlendirin.

| | Kesinlikle Katılmıyorum | Katılmıyorum | Emin Değilim | Katılıyorum | Kesinlikle Katılıyorum |
|---|---|---|---|---|---|
| Eğitimde AG kullanımının avantaj sağlayacağını düşünüyorum. | | | | | |
| AG hakkında daha çok bilgi edinmek isterim. | | | | | |
| AG hakkında daha çok uygulamaya katılmak isterim. | | | | | |
| Katıldığım her eğitimde AG uygulaması görmek isterim. | | | | | |
| AG uygulamalarını eğitimlerimde kullanmak isterim. | | | | | |

## 6. BÖLÜM: ARTIRILMIŞ GERÇEKLİK GÖRÜŞ SORULARI

13. Artırılmış Gerçeklik ile ilgili 3 kelime yazmam gerekseydi...

14. Artırılmış Gerçekliği bir şeye benzetecek olsaydım...

15. Bu deneyimi sevdim çünkü...

16. Bu deneyim sırasında zorlandım çünkü...

APPENDIX F

INTERVIEW QUESTIONS (ENGLISH)

**1. PART: AR FEATURES/BENEFITS**

- Are there any features of AR technology that you liked? If so, what?
- Do you think that there are any the advantages / benefits of AR?

**2. PART: AR LIMITATIONS/SUGGESTIONS**

- Did you encounter any difficulties in using AR technology? If so, what are these?
- Do you think that there are any disadvantages / limitations of AR?
- What are your suggestions for the development of AR technology?

**3. PART: AR USE IN EDUCATION**

- Do you think that you can use AR technology in your trainings?

APPENDIX G

INTERVIEW QUESTIONS (TURKISH)

**1. BÖLÜM: AG ÖZELLİKLERİ/AVANTAJLARI**

- AG teknolojisini hoşunuza giden özellikleri var mıydı? Varsa nelerdir?
- Sizce, avantaj/faydaları neler olabilir?

**2. BÖLÜM: AG ZORLUKLAR/ÖNERİLER**

- AG teknolojisini kullanımında zorluklarla karşılaştınız mı? Varsa bunlar
- Sizce dezavantaj/sınırlılıkları neler olabilir?
- AG teknolojisinin geliştirilmesine yönelik varsa önerileriniz nelerdir?

**3. BÖLÜM: AG'NİN EĞİTİMDE KULLANIMI**

- AG teknolojisini eğitimlerinizde kullanmayı düşünür müsünüz?

APPENDIX H

ANSWERS OF OPEN-ENDED QUESTIONS

IN EVALUATION SURVEY

Table H1. The Summary of Answers for First Question in Turkish

| Artırılmış Gerçeklik ile ilgili 3 kelime yazmam gerekseydi...<br>*(If I needed to write 3 words about AR ...)* | Toplam Yanıt (*Total*) | Oranı *(Frequency)* |
|---|---|---|
| Aktif öğrenme ve akılda kalıcılık<br>*(Active learning and retention)* | 11 | 26% |
| Gelecek, yeni teknolojiler<br>*(Future, new technologies)* | 10 | 23% |
| İçindeymiş (yaşamış) gibi hissetmek, deneyim edinmek<br>*(Feeling inside, experience)* | 10 | 23% |
| İlham, merak, heyecan<br>*(Inspiration, curiosity, excitement)* | 7 | 16% |
| Eğlence, keyif, motivasyon<br>*(Fun, pleasure, motivation)* | 7 | 16% |
| Sanal gerçeklik<br>*(Virtual reality)* | 6 | 14% |
| Farklı, yenilikçi, yaratıcılık<br>*(Different, innovative, creativity)* | 5 | 12% |
| Hayalgücü, hayal dünyası<br>*(Imagination)* | 5 | 12% |
| Somutlaştırmak, görsel etki<br>*(Visualization)* | 3 | 7% |
| Hayranlık, etkileyici, büyüleyici<br>*(Fascination, impressive, fascinating)* | 3 | 7% |
| Faydalı, işlevsel<br>*(Useful)* | 3 | 7% |
| Önemli<br>*(Important)* | 2 | 5% |

| | | |
|---|---|---|
| Açık, Anlaşılır<br>*(Clear)* | 2 | 5% |
| Eğitimde kolaylık<br>*(Easy training)* | 2 | 5% |
| İnteraktif<br>*(Interactive)* | 1 | 2% |
| Devrim<br>*(Revolution)* | 1 | 2% |
| Zaman kazandıran<br>*(Timesaving)* | 1 | 2% |
| Olgunlaşması gereken<br>*(Immature)* | 1 | 2% |
| Augmented Reality<br>*(Augmented Reality)* | 1 | 2% |
| Aurasma, Blippar, Google Glass<br>*(Aurasma, Blippar, Google Glass)* | 1 | 2% |
| Bulut Bilişim, 3D yazıcı<br>*(Cloud computing, 3D printer)* | 1 | 2% |

Table H2. The Summary of Answers for Second Question in Turkish

| Artırılmış Gerçekliği bir şeye benzetecek olsaydım...<br>*(If I would like to see AR as something ...)* | Toplam Yanıt (*Total*) | Oranı *(Frequency)* |
|---|---|---|
| Rüya, hayal, hayal dünyası<br>*(Dream)* | 8 | 24% |
| Bilim kurgu filmi<br>*(Science fiction movie)* | 5 | 15% |
| Hayalet<br>*(Ghost)* | 2 | 6% |
| Sihirli değnek, sihirbazlık<br>*(Magic wand, magic)* | 2 | 6% |
| Akvaryum<br>*(Aquarium)* | 2 | 6% |
| Gizli bir bahçeye açılan bir kapı, pencere<br>*(A window/door to a secret garden)* | 2 | 6% |
| Simülasyon<br>*(Simulation)* | 2 | 6% |
| Hayat<br>*(Life)* | 1 | 3% |
| Zaman makinesi<br>*(Time Machine)* | 1 | 3% |
| Işınlanmak<br>*(Teleport)* | 1 | 3% |
| Kar küresi<br>*(Snow globe)* | 1 | 3% |
| Renkli esnek halat<br>*(Flexible colorful rope)* | 1 | 3% |
| Beyin<br>*(Brain)* | 1 | 3% |
| Dünya turu<br>*(World tour)* | 1 | 3% |
| Oyun konsolu<br>*(Game console)* | 1 | 3% |

Table H3. The Summary of Answers for Third Question in Turkish

| Bu deneyimi sevdim çünkü…<br>*(I like this experience because ...)* | Toplam Yanıt (*Total*) | Oranı *(Frequency)* |
|---|---|---|
| Öğrenmeyi kolaylaştırıyor, akılda kalıcıydı, eğitici/ öğreticiydi, eğitimlerin daha keyifli verimli olacağını düşündürdü<br>*(It facilitated learning, it was reminiscent, it was educative / instructive, it made the trainings more enjoyable)* | 10 | 26% |
| Farklı bir deneyimdi<br>*(It was a different experience)* | 9 | 23% |
| Eğlenceliydi<br>*(It was fun)* | 8 | 21% |
| Şaşırtıcıydı / hayranlık uyandırıcıydı / heyecan vericiydi<br>*(It was amazing / it was fascinating / it was exciting)* | 4 | 10% |
| İlgi çekiciydi<br>*(It was interesting)* | 2 | 5% |
| Hayal gücümü geliştirdi / yaratıcılığımı pekiştirdi<br>*(It developed my imagination / strengthened my creativity)* | 2 | 5% |
| Farklı düşünmemi sağladı<br>*(It provided me to think differently)* | 2 | 5% |
| Yeni şeyleri denemeyi seviyorum<br>*(I like trying new things)* | 2 | 5% |
| Teknoloji çağına ait hissettim<br>*(It made me feel belong to technology age)* | 2 | 5% |
| Hem eğitimlerde hem de işimde kullanabilirim<br>*(I can use it both in training and at work)* | 2 | 5% |
| Gerçekle iç içeydi<br>*(It was nested with reality)* | 1 | 3% |

| | | |
|---|---|---|
| Ortamın içinde hissettirdi, bu da bana daha gerçekçi kararlar verebileceğimi düşündürdü<br>*(It made me feel inside real the environment, and this made me think that I could make more realistic decisions)* | 1 | 3% |
| Gelecekle ilgili fikir verdi<br>*(It gave an idea about the future)* | 1 | 3% |
| Çok yakında hayatımızın içine gireceğini düşünüyorum<br>*(I think that it will enter our life very soon)* | 1 | 3% |

Table H4. The Summary of Answers for Fourth Question in Turkish

| Bu deneyim sırasında zorlandım çünkü…<br>*(I am tough during this experience because …)* | Toplam Yanıt (*Total*) | Oranı *(Frequency)* |
|---|---|---|
| İlk defa deneyimledim<br>*(I experienced it for the first time* | 7 | 29% |
| Zorlanmadım/sevdim<br>*(I was not forced, I liked it)* | 7 | 29% |
| Teknolojiye uzak olduğum için zorlandım<br>*(I was forced because of being away from technology)* | 2 | 8% |
| Cardboardu kullanmak zordu<br>*(It was difficult to use the cardboard)* | 2 | 8% |
| Telefonumla ilgili teknik problemler yaşadım<br>*(I experienced technical problems related with my phone)* | 2 | 8% |
| Kabullenmek ve teknolojiye adapte olmak zordu<br>*(It was difficult to accept and adopt to technology)* | 1 | 4% |
| Eğitimlerde nasıl kullanacağımı düşünüyorum<br>*(I think about how to use it in trainings)* | 1 | 4% |
| Cardboard/gözlük daha profesyonel olabilirdi<br>*(Cardboard / glasses could be more professional)* | 1 | 4% |
| Gözlerim ağrıdı<br>*(My eyes were painful in cardboard)* | 1 | 4% |
| Başım döndü<br>*(I got dizzy)* | 1 | 4% |
| Cardboard midemi bulandırdı<br>*(Cardboard caused nausea)* | 1 | 4% |
| Hayal gücümü zorladı<br>*(It forced my imagination)* | 1 | 4% |

# APPENDIX I

## INTERVIEW RESULTS

Table I1. Answers for First Question

| AG teknolojisini hoşunuza giden özellikleri var mıydı? Varsa nelerdir? *(Are there any features of AR technology that you liked? If so, what?)* | Toplam (*Total*) |
|---|---|
| Ses ve görüntü desteği sayesinde aynı ortamdaymış gibi hissettim. *(Audio and visual support of AR environment made me feel as if I was in the same environment.)* | 4 |
| Normal şartlar altında ulaşamayacağım şeylerle etkileşime girerek aynı ortamdaymış gibi hissettim, içselleştirmemi sağladı. *(Interacting with situations and concepts that I would not be able to access under normal conditions made me feel like I was in the same environment.)* | 2 |
| Dokunma etkileşimi, öğrenen kişinin kontrole sahip olduğunu hissettiriyor. Bu yöntem sayesinde kısa sürede çok fazla şeyi aynı anda öğrendim. *(The feeling of touching made me feel that I had in control of my learning. I learned many things in a short time.)* | 1 |
| Kişinin kendi kontrolünde olması. *(I learned unwittingly by wondering.)* | 1 |
| Öğrenirken farkında değildim, kendiliğinden merak ederek içinde hissederek öğrendim. *(I learned unwittingly by wondering.)* | 1 |
| Farklılıklar beni heyecanlandırıyor ve ilginç geliyor. Katılımcılara da aynı etkiyi yaratacağını düşünüyorum. *(I was excited about such different environments and I found these environments interesting. I think AR would attract attention of my students.)* | 1 |
| Doğaüstü ya da süper güçlerim varmış gibi hissettirdi. Terminatör havası yarattı. *(I felt like having supernatural or superpowers.)* | 1 |
| Eğlenmemi sağladı ve ilgimi çekti. *(I had fun in this experience.)* | 1 |
| Yaratıcı çalışmalar yapabileceğimi hissettirdi. *(I could do creative work.)* | 1 |
| Dijital dönüşüm konusunda önemli bir adım olduğunu düşündüm. *(AR would be an important step in digital transformation.)* | 1 |

Table I2. Answers for Second Question

| Sizce, avantaj/faydaları neler olabilir?<br>*(Do you think that there are any the advantages / benefits of AR?)* | Toplam (*Total*) |
|---|---|
| Eğlenceliydi.<br>(*It was fun.*) | 3 |
| İlgi çekiciydi/motive ediciydi.<br>*(It was engaging and motivating.)* | 2 |
| Kolay ulaşılabilir, erişilebilir olması.<br>*(AR examples were easily accessible.)* | 2 |
| Gerçekle iç içeydi.<br>*(I experienced reality and virtuality at the same time together.)* | 1 |
| Yeni jenerasyonun beklentilerine uygun bir yöntem olması.<br>*(It was an appropriate method for satisfying the expectations of the new generation.)* | 2 |
| Kavramları görselleştirerek kolay öğrenilmesini sağlar.<br>*(Visualizing concepts made learning easier.)* | 2 |
| Soyut kavramları somutlaştırarak kolay öğrenilmesini sağlar.<br>*(Embodying abstract concepts facilitated the learning process.)* | 2 |
| Yaşayarak ve deneyimleyerek öğrenmeye katkı sağlar.<br>*(AR has contributed to learning by living and experiencing.)* | 1 |
| Öğrenmeyi kolaylaştırıyor, akılda kalıcıydı, eğitici/ öğreticiydi, eğitimlerin daha keyifli verimli olacağını düşündürdü.<br>*(Remembering just learned items was easier with AR. In addition, AR was more instructive as well as more enjoyable experience.)* | 3 |
| Basılı materyaller daha kolay güncellenebilir ve daha ilgi çekici olabilir.<br>*(Printed materials would be more interesting with AR support and these materials could be updated more easily in AR platform.)* | 3 |
| Afişler daha çok ilgi çekebilir.<br>*(AR-supported posters would also attract more attention.)* | 1 |
| E-öğrenmeyi daha interaktif hale getirebilir.<br>*(AR could make e-learning more interactive.)* | 1 |
| Riskli uygulamalarda güvenle deneyim edinilmesini sağlar.<br>*(Participants would be able to gain experience safely in risky applications with the help of an AR application.)* | 1 |
| Saha ziyaretlerinde gidiş-geliş vb. gerekliliğini azaltır.<br>*(The number of field trips could decrease by using AR supported examples.)* | 3 |
| Maliyet ve zamandan tasarruf sağlar.<br>*(AR could be able to contribute to cost and time-saving.)* | 3 |

Table I3. Answers for Third Question

| 3. AG teknolojisini kullanımında zorluklarla karşılaştınız mı? Varsa bunlar nelerdir?<br>*(Did you encounter any difficulties in using AR technology? If so, what are these?)* | Toplam (*Total*) |
|---|---|
| Olmadı.<br>*(Nothing)* | 7 |
| Telefon dondu ve kapandı.<br>*(I had a technical problem related with my phone.)* | 1 |
| Daha önce tecrübe etmediğim için anlama aşamasında zorlandım.<br>*(I did not have any prior knowledge about AR and thus it was difficult to understand AR examples.)* | 1 |
| 3D deneyimi çok hissedemedim.<br>*(I could not feel 3D experience very much.)* | 1 |
| VR'da gözlüğü kullanırken odaklanma problemi yaşadım.<br>*(I had a problem with cardboard while focusing on a point.)* | 2 |
| VR gözlüğü taktığımda özgürlüğümün kısıtlandığını, görmediğim bir ortamda tehlike altında olabileceğimi hissettim.<br>*(When I used cardboard, I felt like my freedom was limited. I think, virtual experience might be dangerous since I could not see the real environment.)* | 1 |
| Teknolojiye uzak bir noktada olduğumu düşündüm ve bu his beni eksik hissettirdi, deneme cesaretim kayboldu.<br>*(I felt away from the technology and due to this feeling, I lost my courage for AR experience.)* | 1 |

Table I4. Answers for Fourth Question

| Sizce dezavantaj/sınırlılıkları neler olabilir?<br>*(Do you think that there are any disadvantages / limitations of AR?)* | Toplam (*Total*) |
|---|---|
| Gördüğüm örnekler beni heyecanlandırıyor ama nasıl uygulayacağımı bilmiyorum.<br>*(I excited about AR experience and I want to discover AR technology. However, I do not know the basic technical information about the AR.)* | 3 |
| Kültür ve zemin hazır olmadan ortaya çıkan yenilikler maalesef tutunamıyor. Burada da bu nedenle başarısızlıkla karşılaşılabilir.<br>*(When the society is not ready for innovations in terms of knowledge and culture, new projects would fail.)* | 1 |
| İnsana olan ihtiyaç azalır mı?<br>*(I wondered about whether the need for humanbeings could decrease.)* | 1 |
| Psikolojik etkileri üzerine düşündüm. Duygularımızı nasıl etkiler?<br>*(I had worried about how the feelings of human beings would be affected.)* | 2 |
| Gerçek yaşantıya olan ilgimiz azalır mı? Sanal durum ve koşullar daha mı cazip gelir? Bu şekilde doğamızdan uzaklaşır mıyız?<br>*(I thought about the virtual effect on our interest in real life.)* | 1 |
| Hayalgücünü kısıtlayabilir. Araştırma kası, merak duygusu körelir mi gibi sorular aklıma geldi.<br>*(AR technology would limit our imagination and prevent our curiosity.)* | 2 |
| İçinde bulunduğu ortamdan kopması tehlikeli sonuçlar yaratabilir. PokemonGo'yu tehlikeli bulmuştum.<br>*(Breaking out of the environment in which the person was present might create dangerous consequences like PokemonGo example.)* | 1 |
| Katılımcılara teknolojiyi anlatmak gerekiyor. Bu da ek bir çaba getirir.<br>*(It would be required to teach AR technology to the students and this would be an additional effort.)* | 1 |
| Sınıf yönetimi konusunda endişelerim oluştu. Katılımcıların birisi yaparken diğeri yapamazsa vb.<br>*(I had some thoughts about how I would manage the class when some students could use AR successfully some other could not.)* | 1 |

| | |
|---|---|
| Bilmediğim programları yüklemek ve kullanmakta zorluk yaşayabilirim.<br>*(It would be to install the unknown programs.)* | 2 |
| Uygulamaların içindeki navigasyon ve kullanım özellikleri önemli<br>*(I would be important having easy navigation and usage features in the application.)* | 1 |
| İnternet paketini tüketmek istemeyen katılımcıları nasıl yöneteceğimi düşündüm.<br>*(I though that my students could not want to consume their internet package.)* | 2 |
| Kaynak ve imkan yeterli olmayabilir.<br>*(I stressed about the financial issues and sources.)* | 1 |

Table I5. Answers for Fifth Question

| AG teknolojisinin geliştirilmesine yönelik varsa önerileriniz nelerdir? *(What are your suggestions for the development of AR technology?)* | Toplam (*Total*) |
|---|---|
| Yok *(Nothing)* | 2 |
| Platform bağımsız olsa çok güzel olurdu. Instagram, facebook üzerinden kullanabilsem çok faydalı olurdu. İndirdiğim uygulamayı hayatımın diğer alanlarında da kullanılabileceğimi bilmek isterdim. Daha yaygınlaşabilirdi. *(It would be nice if the application was platform and device independent and they could use the application in other areas of their life. For example, when people could use AR inside Instagram or Facebook application, it could become a widely known technology.)* | 2 |
| Konum olarak şu an çok arada kalmış gibi geldi. Reklam dünyası kullanacaksa, diğer insanların erişemeyeceği bir şey olarak lanse edilmeli, insanlar ilgi duyduktan sonra diğer sektörlere açılabilir. Ya da tamamen herkesin kullanımına açık, bedava, kolay kullanımı olan bir şekilde olmalı. *(Since AR is a developing technology, there is a need for strategical positioning for AR. Nowadays, advertisement sector uses more AR technology since it is attractive for society. I think, it must be completely free, people should be able to easily access and use AR technology to develop day by day.)* | 1 |
| Yolda yürürken karşıma çıkan şeyleri okutabilsem, mesela insanların kıyafet ya da ayakkabı, çantası ya da bir arabanın markası. Yolda gördüğüm herhangi birşeyi okutup detayını görsem. Bir yiyeceği okutup nasıl yapıldığını izleyebilsem. *(I wish I could learn about the details of the things that I confronted with while walking on the road with the help of an AR application, such as clothes, shoes, a bag or a car's brand. Or, I wish I could learn about the details of a dish in a restaurant such as in what conditions it was cooked.)* | 2 |
| Kullanımı kolaylaşırsa, insan beyninin daha kolay algılayabileceği bir öğrenme şekli olabilir. *(If AR becomes easier to use, it may be a form of learning that the human brain can more easily perceive.)* | 1 |
| Teknolojik imkanlar gelişmeli. İnternet paketi önemli bir kısıt, bu konuda esneklik sağlanmalı. *(Technological opportunities should be developed. For instance, internet package is an important constraint, flexibility should be provided in this regard.)* | 1 |
| Uygulamayı açtıktan sonra okutulan ve yaşanılan etkileşim, uygulama hafızasında kalsa ve yeniden okuttuğunda tekrar yüklenmese iyi olurdu. | 1 |

| | |
|---|---|
| *(It will be good if the downloaded data can be saved in application's memory.)* | |
| Navigasyon konusu iyileşebilir. İlk kez okuttuğumda en baştan, ikinci okuttuğumda ise kaldığınız yerden devam etmek ister misiniz gibi sorular olabilir.<br>*(The navigation aspect should be improved. When I open the application, AR should remember my last step, and it should take me to that point because I do not want to start from the beginning each time.)* | 1 |
| Eğitmenler tarafından yapılan örneklerin toplandığı bir havuz olsa, örnekler etiketlense (tag) daha çok kişi erişebilirdi.<br>*(If all AR used examples could be tagged by trainers and these examples could bring together in a pool, all trainers could access to a number of best practices.)* | 1 |
| Kişiselleştirilmiş bir deneyim sağlamasını isterdim. Daha içinde hissetmeyi sağlayan hareketlerimi algılayan araçlar ya da joystick olabilir. Görme ve duyma etkisi güzel ama hisleri de devreye sokabilsek tam bir deneyim olurdu.<br>*(I wish, I had a more personalized experience with the help of some tools that help me feeling more senses. For example, it would be great, if I felt the taste or texture of the thing in AR experience.)* | 3 |
| VR için gözlüğü takınca duyma yetisine de hitap eden bir kulaklık olursa, daha içinde hissedebilirim.<br>*(In VR experience, I wanted to try a headset providing me to hear voices closer like in the real environment.)* | 1 |

Table I6. Answers for Sixth Question

| AG teknolojisini eğitimlerinizde kullanmayı düşünür müsünüz? *(Do you think that you can use AR technology in your trainings?)* | Toplam (*Total*) |
|---|---|
| Davranış geliştirmeye yönelik eğitimlerimde kullanmak isterim.<br>Örnek olarak;<br>• Zaman Yönetimi: Bilgi kartları olabilir. Okuttuğumda bilgilere erişilebilir.<br>• Birlikte Başarma Eğitimi: Define Avı oyunu tasarlayıp ipuçlarını okutup öğrenebilir.<br>• Koçlukla Gelen Liderlik eğitiminde "Değerler" konusunun ve "Güçlü Yönler" konusunun somutlaşması için kullanmak istiyorum.<br>*(Recommendations for AR usage in behavioral development trainings from three participants are as follows:*<br>• *"There may be some flashcards in Time Management training. Participants can use the phone camera to read the flashcard and they can reach detailed and animated information."*<br>• *"For Successful Team training, Treasure Hunt game can be designed. In the game board, some cues and learning tips can be discovered via AR."*<br>• *"Values and strengths topics can be embodied in Leadership Coaching training."* | 3 |
| Oryantasyon süreçlerinde, binanın içinde gezilen her noktada bulunan departmanı kişi ya da uygulamayı anlatan bir çalışma yapılabilir.<br>*(During the orientation process, there could be an AR example for a new employee to learn about a person or processes of departments.)* | 1 |
| Tekstil - Perakende alanındaki mesleki eğitim örnekleri:<br>Kapasite Eğitimi: Raf, fixture gib soyut kavramları daha iyi anlamalarını sağlar.<br>*(Recommendations for AR usage in Textile Retail vocational trainings: For Capacity Training: "AR can be used to embody some abstract concepts like shelf and fixture.")* | 1 |
| Range Eğitimi: Doğru kombinlenmiş bir mağaza görüntüsü ile doğru olmayan arasındaki farkları görebilir.<br>Range Planlama eğitiminde, tüketicilerin davranışlarını canlandırabiliriz.<br>- Talimatların anlaşılır hale gelmesi için kullanılabilir.<br>- Mağaza ortamında deneyimlenmesi istenen davranış ve durumlar bu yolla sağlanabilir.<br>*(For Range Training: "AR can be used to see the difference between a correctly combined store image and the wrong one. At the same time, in Range Planning training, participants can have the opportunity to observe consumers' simulated behaviors. In addition, AR can be used to make some instructions and procedures clearer in these processes."* | 2 |

| | |
|---|---|
| Kumaş eğitiminde, farklı dokulardaki kumaşlar canlandırılabilir.<br>*(For Fabric Training: "AR can be used to understand the feel of fabrics in different textures.")* | 1 |
| Fit Eğitimi sırasında ürün prova mankenleri canlandırılabilir.<br>*(For Fit Training: "The stage of wearing the product in rehearsal models can be animated in three dimensions via AR.")* | 1 |
| Moda Tarihi ile ilgili bir eğitimde, canlandırmalar ile katılımcılar daha içinde hissedebilir. Canlanan defileler olabilir.<br>*(For Fashion History Training: "AR can provide for the participants to feel in a fashion show.")* | 1 |
| Dikiş Teknikleri konusunda deneyimsiz kişilerin bu yöntemle güvenli bir öğrenme deneyimi yaşaması güzel olurdu.<br>*(New beginners to stitching techniques might experience a safe learning experience with this method.)* | 1 |
| Saha ziyaretinin gerekli olduğu durumlarda uygulanabilir. Kumaş fabrikası ziyaretleri örnek olabilir.<br>*(AR can be used in shop visits and field trips. For example, in fabric factories, there are various big machines. Investigating their working principle or their special parts may be harmful to inexperienced people. In these times, people can get the detailed information or procedures of these machines without touching the real machine via AR under safe conditions.* | 1 |
| Mağaza Ziyareti sırasında, zaman ve maliyet yükünden kurtulmak için faydalı olabilir. İlave olarak aşağıdaki faydalara katkı sağlar:<br>- Farklı ülkelerdeki müşteri profillerini deneyimlemek,<br>- Farklı iklim koşullarını deneyimlemek.<br>*(Via AR supported store visits, participants can experience the features of different countries, cultures, weather, climate, and consumer behavior as well as time and cost savings.)* | 1 |

Table I7. Answer for Seventh Question

| Başka ne bilmek isterdiniz? Öneri/istek<br>*(Do you want to add any idea or suggestion? If so, what is this?)* | Toplam |
|---|---|
| Nasıl yapıldığını temel düzeyde bilmek isterdim.<br>*(I wanted to know how AR supported training content could be prepared at a basic level.)* | 1 |

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