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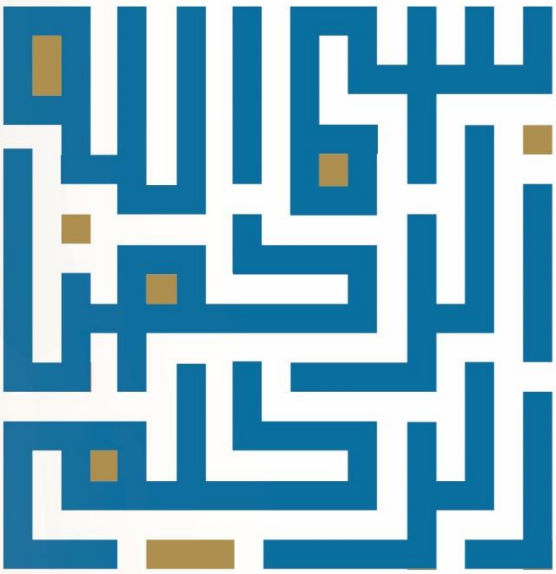
البحوث المنشورة في المجلة تعبرعن آراء الباحثـين ولا تعبر بالضرورة عن رأي المجلة



قواعد وضوابط النشر في المجلة

- أن يتسم البحث بالأصالة والجدية والإبتكار والإضافة المعرفية في التخصص.
- لم يسبق للباحث نشر بحثه.
- أن لا يكون مستلاً من بحوث سبق نشرها للباحث.
- أن يلتزم الباحث بالأمانة العلمية.
- أن تراعى فيه منهجية البحث العلمي وقواعده.
- أن لا تتجاوز نسبة الاقتباس في البحث المقدم (25%) .
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- لا يحق للباحث إعادة نشر بحثه المقبول للنشر في المجلة إلا بعد إذن كتابي من رئيس هيئة تحرير المجلة.
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- يلتزم الباحث بترجمة المصادر العربية إلى اللغة الإنجليزية.
- يرسل الباحث بحثه إلى المجلة إلكترونيًا ، بصيغة (WORD) وبصيغة (PDF) ويرفق تعهدًا خطيًا بأن البحث لم يسبق نشره ، وأنه غير مقدم للنشر. ولن يقدم للنشر في جهة أخرى حتى تنتهي إجراءات تحكيمه في المجلة

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❋ ترتيب الأبحاث حسب تاريخ ورودها للمجلة مع مراعاة تنوع التخصصات

Examining Saudi's Secondary School Teachers' Acceptance of Augmented Reality Technology

إعداد

د. حامد علي الشهراني

أستاذ تكنولوجيا التعليم المساعد

بجامعة الملك الخالد

المستخلص

هدفت الدراسة إلى التحقق من نية المعلمين السلوكية في تبني واستخدام الواقع المعزز في المملكة العربية السعودية. مجتمع الدراسة يتشكل من المعلمين في ١٤ مدرسة ثانوية عامة للبنين في مدينة أبها. تم اختيار١٨٨ معلمًا منهم كعينة ممثلة، وزعت عليهم استبانة اشتملت على عوامل مختلفة لقياس مدى تقبلهم للواقع المعزز. وتم استخدام نموذج قبول التكنولوجيا لبناء أداة الدراسة. وتم اختبار خمسة عوامل ضمن فرضيات الدراسة كانت كالتالي: الفائدة المتصورة، وسهولة الاستخدام، والاتجاهات نحو الاستخدام، والنية السلوكية للاستخدام، والمتعة المتصورة. وأكدت هذه الدراسة أن النموذج المقترح والمعدل على نموذج قبول التكنولوجيا يعتبر أداة نظرية تساعد في فهم وتفسير النية السلوكية لاستخدام الواقع المعزز، وتوصلت نتائج الدراسة إلى أن الفائدة المتصورة، والاتجاهات نحو الاستخدام لها تأثير على النية السلوكية للاستخدام. كما تشير نتائج الدراسة إلى تأثير الفائدة المتصورة، والمتعة المتصورة على اتجاهات المعلمين نحو استخدام الواقع المعزز، ولكن لا يوجد تأثير مباشر لسهولة الاستخدام على اتجاهاتهم. كان هناك عدد قليل من الدراسات المتعلقة بالواقع المعزز درست العلاقات بين عامل المتعة المتصورة والعوامل الأخرى المكونة لنموذج قبول التكنولوجيا، لهذا، فالنتائج التي توصلت إليها الدراسة الحالية تقدّم مرجعًا مفيداً للدراسات المستقبلية حول استخدام نموذج قبول التكنولوجيا وتقنية الواقع المعزز. واختتمت الدراسة بمجموعة من المقترحات والتوصيات، والتطبيقات الممكنة للواقع المعزز لتحسين أساليب التدريس لدى المعلمين.

الكلمات المفتاحية: نموذج قبول التكنولوجيا (TAM)، الواقع المعزز، المدارس الثانوية

Introduction

We live in a digital age where technologies have had a transformative effect on the way we live and work. Education is one of the fundamental organizations that are being distributed by technology and digitalization. Slowly and steadily, technology has been making strides in revolutionizing methods of learning and teaching. Technology-enabled curriculum and smartboard interactive whiteboards have long replaced a traditional chalk blackboard and a two-dimensional textbook image. One change that is making vital waves in education is the arrival of "Generation Z," born from ١٩٩٧ onward (Dimock, ٢٠١٩). Today's generation of students no longer want traditional education methods, which are becoming a thing of the past and becoming increasingly digitized and driven by technology innovations. They want the power of technology to be integrated into their classrooms. Recent technological innovations present meaningful opportunities to reshape ٢١st-century instruction because of their popularity with learners and instructors. According to a survey on the impact of interactive technology on Marketing college students, it indicated that the introduction of technology makes ٨٧٪ of students reported they were more likely to attend class, ٧٢٪ of students reported they were more likely to participate, and ٧٠٪ of students reported they improved their understanding of specific concepts (Anonymous, ٢٠٠٦, p.١) .

Most young people have grown up never knowing a world without smartphones, and they use them for just about everything, and it seems evident that using such technologies can help them to learn. Smartphone ownership has become a nearly ubiquitous element of a teenager's life. According to a research by the Pew Institute, nearly all adolescents and young adults age ١٣-١٧ (٩٥٪) have a smartphone or access to one (Anderson & Jiang, ٢٠١٩), and these devices contribute positively to education (Radosavljevic et al., ٢٠١٨).

Most people's first experiences of immersive technologies such as augmented reality (AR), virtual reality (VR), and mixed reality (MR), today are likely to be in gaming and entertainment. AR, along with VR and MR, is considered "key educational technologies over the next decade" (Becker et al., ٢٠١٨, p. ٤٦). A study by eMarketer reported that about ٤٢,٩

million people would use VR, and ٦٨,٧ million will use AR at least once a month (Petrock, ٢٠١٩). According to a Statista report, AR is expected to have one billion users by ٢٠٢٣. Worldwide shipments of smart glasses are expected to reach around ٣٢,٧ million units by ٢٠٢٢, growing from ٢٢٥ thousand in ٢٠١٧. According to Liu (٢٠١٩), the global AR market is expected to grow noticeably to around ١٩٨ billion American Dollars by ٢٠٢٥.

As we move into the next generation of media transformation, AR is becoming the hottest topic in education. AR is a powerful visualization tool that allows users to bring an object or concept into a reality that is otherwise imagined, inaccessible, or difficult to grasp, and even help make the invisible visible. AR refers to a technology that enables the combination of real-time digital and physical information utilizing various forms of portable computing devices—i.e., iPads, laptops, tablets, and smartphones with wireless networks— to create this new reality, which has affected the number of mobile AR applications (Cabero-Almenara et al., ٢٠١٩).

AR is one with the fastest growth (Arcos et al., ٢٠١٦), becoming more popular as it was forecasted (Akçayır & Akçayır, ٢٠١٧), and this growth is anticipated to be sustained. AR holds great promise for various fields of study and has begun to be applied in many different disciplines where simulations and other immersive and experiential learning pedagogies have been highly successful (Hsin-Hun et al., ٢٠١٧; Ho et al., ٢٠١٧). AR has become an emergent technology with numerous diverse possibilities for its application in educational contexts (Akçayır & Akçayır, ٢٠١٧; Cabero-Almenara et al., ٢٠١٩; Ibili et al., ٢٠١٩) .

Today's students are quickly bored with standardized teaching approaches and tend to remember what they see more than what they learn by rote; hence, AR could take them to the next level by assisting them not only to see but also to experience and participate. According to Cabero-Almenara et al. (٢٠١٩), AR has been shown to increase learners' visualization capabilities. Various potentials of AR for teaching and learning have been increasingly recognized by academics (i.e., Chen et al., ٢٠١١; Khan et al., ٢٠١٩) who have reported the potential of utilizing AR to assist students learning in real-world contexts compared to traditional education systems. AR has been applied for enhancing students' attention

(Escobedo & Tentori, ٢٠١٤), leading positive learning outcomes (Chen, & Wang, ٢٠١٥), improving learners writing skills (Wang, ٢٠١٧), increasing the student learning motivation in the learning process (Khan et al., ٢٠١٩), promoting students' interaction and engagement (Scrivner et al., ٢٠١٦), encouraging collaborative learning and enhancing existing learning materials (Akçayır & Akçayır, ٢٠١٧; Lytridis & Tsinakos, ٢٠١٨), and offering efficiency in the learning (Sytwu & Wang, ٢٠١٥). By providing visual representations, AR enables learners to acquire, process, and remember information; thus, it benefits them in testing their knowledge in practice. Such technology has been applied to provide learners with immediate and relevant information such as videos and ٣D images to facilitate their processing skills and increase their learning motivation and level of understanding (Chiang et al., ٢٠١٤).Yoon et al. (٢٠١٧) indicated that AR had been highlighted for its tremendous potential to empower learners to better understand difficult subjects .

Appling AR in the real world can effectively help students in reaching their learning goals (Hsu, ٢٠١٧), and benefit teachers in teaching subjects that can be complicated and costly to explain and make them clearer (Erbas & Demirer, ٢٠١٩). AR is an emerging trend within the education area, one that empowers educators to give learners different experiences with the convenience of utilizing their devices. Teachers could easily and quickly convey concepts to students who study the learning materials supported by applying AR before lessons (Liou et al., ٢٠١٦). AR empowers teachers by providing exciting digital content and features that can engage learners in no time. Scrivner et al. (٢٠١٦) indicated that AR offers opportunities for more authentic learning experiences and appeals to multiple learning styles, providing learners with a personalized and explorative learning experience. Educational associations have recognized AR as one of the most promising technologies (Ibáñez & Delgado-Kloos, ٢٠١٨) that will be adopted by educators in the next years (Scrivner et al., ٢٠١٦), and become the milestone of education. Cabero-Almenara et al. (٢٠١٩) concluded that AR would significantly contribute to the future education process.

Problem Statement

The academic year ١٤٣٦-١٤٣٧ AH witnessed the opening of the National Education Portal "iEN," and this project is considered as one of the emerging ministerial projects as a result of the sense of the Ministry of Education in the Kingdom of Saudi Arabia (KSA) [National Education Portal (iEN), ٢٠٢٠]. iEN provides reliable e-educational services to all students, teachers, educational leaders, supervisors, and parents. It allows teachers to create teaching and learning strategies based on the current century's requirements and provides students with self-learning opportunities according to their abilities and academic level. AR is one of the new technology services provided by iEN, as it shows visitors the images supported in textbooks using special applications produced by the development services for education. These applications work on Android and iOS to contribute to enhancing the practices of this technical innovator in teaching and learning processes. Currently, iEN supports the curriculum of science at intermediate and secondary schools as a first step in providing this service. However, the use of AR technology in the Saudi educational context is in its infancy .

The acceptance of AR is a topic of growing interest in educational environments. Users' acceptance is a fundamental factor in determining the success or failure of new technologies (Davis, ١٩٨٩, ١٩٩٣). A key question for researchers, academicians, and practitioners is whether users would accept AR technology in their academic settings by investigating all essential factors that ensure the successful deployment of this technology. Educators are probably the most important element in the educational process, and they play a vital role in the success of technology acceptance and adoption in teaching and learning .

Nevertheless, a recent review showed that few studies had been conducted to identify the extent to which educators are willing to accept AR technology in their settings. To ensure the success of AR, it is important to examine the teachers' perceived intention to use it as the first step in implementing it in their teaching practice. Since there is a gap in the literature regarding the acceptance of AR in the context of education, this study aims to fill this gap by examining the relationship between perceived usefulness (PU), perceived ease of use (PEoU), perceived enjoyment (PE), attitude toward use (ATU) and teachers' perceived

intention to use (ITU) AR in the secondary education in Saudi Arabia with Davis's (١٩٨٩) TAM as the guiding principle.

Significance

Since AR is still in its infancy, especially in KSA, an in-depth study of each aspect of this issue is necessary. The current study sought to fill some gaps in the literature and help build a foundation for future research in AR. Research on AR acceptance will be extremely worthy in providing meaningful information, especially at this early stage of AR technology development and implementation. Further, no previous research has sought to investigate secondary teachers' behavioral intention to use AR and empirically validate the technology acceptance model in KSA. The findings of this study will provide the ministry of education in KSA with more insight into academics' perception of AR. This study will also pave the way for future research on technology acceptance within the KSA's higher education setting. Specifically, this study adopted and modified a questionnaire to suit the AR acceptance context that may be reused in future research.

Literature Review

Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM) formulated by Davis (١٩٨٩) is one of the most extensively accepted models to explain a potential user's +TAM's primary purpose is to explain the influence of users' beliefs and attitudes on their intention to use technology and, subsequently, the usage of the technology itself. TAM typically explains ٤٠٪ of the intention to use and ٣٠٪ of actual use (Fishbein & Ajzen, ١٩٧٦). In Davis's (١٩٨٩) TAM, two major variables, perceived usefulness (PU) and perceived ease-of-use (PEoU), are hypothesized to be fundamental determinants of user acceptance. Additionally, Davis's (١٩٨٩) TAM postulates that users' perception of PU and PEoU relative to a particular technology shapes ATU and ITU .

This model has received empirical support for being robust in predicting technology adoption in different contexts and with a variety of technologies, including an augmented reality tutoring system (Ibili et al., ٢٠١٩), augmented reality (Bojórquez et al., ٢٠١٦; Cabero-Almenara et al., ٢٠١٩), learning management system (Yalcin & Kutlu, ٢٠١٩; Yuen et al.,

٢٠١٩), social media (Lemay et al., ٢٠١٩), blended learning (Martín-García et al., ٢٠١٩), smart glasses (Rauschnabel & Ro, ٢٠١٦),YouTube (Maziriri et al., ٢٠٢٠), mobile learning (Sánchez-Prieto et al., ٢٠١٩), multimedia (Weng et al., ٢٠١٨) and information and communication technology (Ursavaş et al., ٢٠١٩). However, it is recommended that the TAM be studied to obtain more insights into its validity (Alalwan et al. ٢٠١٨; Beldad & Hegner, ٢٠١٨). Legris et al. (٢٠٠٣) recommended that Davis's (١٩٨٩) TAM has to be integrated into a broader one, including additional variables to provide an even more robust model.

Research Model and Hypotheses

Relationships among all factors—PU, PEoU, PE, ATU, and ITU—that influence teachers' acceptance of AR were examined in the present study. The expected relationships among these variables can be seen in Figure ١.

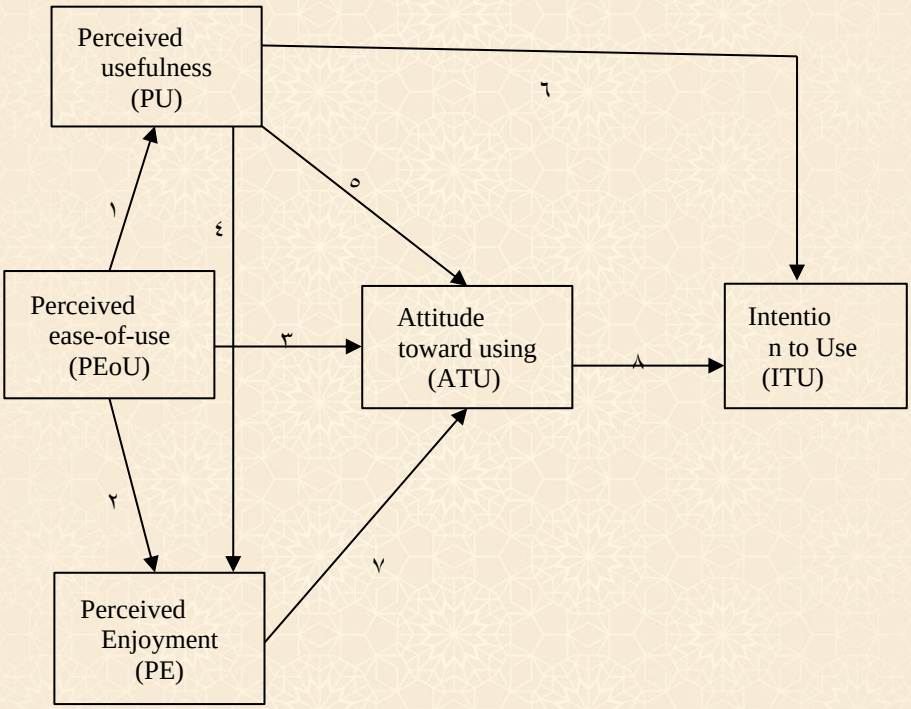

Figure ١: The research model and hypotheses

Perceived Usefulness (PU)

In TAM (Davis, ١٩٨٩), PU is defined as ''the degree to which a person believes that using a particular system would enhance his/her job performance" (p. ٣٢٠). In the current research, PU is the extent to which a teacher believes that using AR will improve his/her teaching performance. This means that if teachers perceive that AR can help them augment their teaching performance, they are more likely to use AR in their future teaching practice. Empirical studies (i.e., Alalwan, et al. ٢٠١٨; Kim et al. ٢٠١٦), have shown that PU is the strongest predictor of the technology of interest. A strong relationship between PU and ITU has been confirmed by several empirical studies (i.e., Haugstvedt & Krogstie, ٢٠١٢; Sánchez-Prieto et al., ٢٠١٧; Revythi & Tselios, ٢٠١٩; Wu & Chen, ٢٠١٧). In the context of AR, Balog, and Pribeanu (٢٠١٠) insisted that PU is a relevant factor for user's acceptance of AR. Briz-Ponce et al. (٢٠١٧) suggested that PU is vital in predicting ATU .

Perceived Ease-of-Use (PEoU)

PEoU is another factor that signifies "the degree to which a person believes that using a particular system will be free of effort" (Davis, ١٩٨٩, p. ٣٢٠). In the context of AR, PEoU is the belief that a teacher expects not to put much effort into making use of AR. Cabero-Almenara et al. (٢٠١٩) argued that AR gets more relevance in education due to its ease of use and availability of mobile computing devices. If AR is relatively easy to use, teachers will be more willing to learn about its features and finally intend to use it in their future teaching practice. Davis (١٩٨٩) suggested that when it comes to introducing the use of new technologies, PEoU would be the critical technical determinant that affects the user's attitude towards usage. Various literature provides evidence of the impact of PEoU on ATU, ITU and PU (Šumak et al., ٢٠١١; Maziriri et al., ٢٠٢٠; Weng et al., ٢٠١٨; Teo, ٢٠١١; Luan & Teo, ٢٠٠٩). Other works, such as Chuah et al. (٢٠١٦) and Haugstvedt and Krogstie (٢٠١٢), found that PEoU strongly influences PU, PE, and ITU. However, Balog and Pribeanu (٢٠١٠) has found no such relationship. In AR contexts, A research conducted by Iba'nez et al. (٢٠١٦) reported that PEoU is a vital factor for the PU and ATU towards using AR. However, Wojciechowski and Cellary (٢٠١٣) found that PEoU had a weak influence on PE. Šumak et al. (٢٠١١) and Luan and Teo (٢٠٠٩) found that PEoU is a significant determinant of ATU and ITU, and PU had a direct

influence on ITU while PEoU affects ITU indirectly through ATU. A study conducted by Yalcin and Kutlu (٢٠١٩) found that PU and PEoU have a statistically significant influence on ITU. Further, the influence of PEoU on PU in TAM research has been empirically confirmed in the literature (Ibili et al., ٢٠١٩; Nikou & Economides, ٢٠١٧) and they found that both factors are two crucial determinants of ITU. Huang (٢٠١٦) found that PEoU was directly related to PU and that both variables had direct effects on ATU, not ITU .

Attitude Toward Use (ATU)

ATU refers to an individual's positive or negative feelings about the performance of target behaviors (Fishbein & Ajzen, ١٩٧٥). Davis (١٩٨٩) stated that in the TAM context, one's overall ATU in a given system is an antecedent to ITU. Based on Davis's (١٩٨٩) TAM, higher levels of PU and PEoU predict positive ATU, which, in turn, predicts ITU. The literature shows that ATU affects ITU (i.e., Maziriri et al., ٢٠٢٠; Sánchez-Prieto et al., ٢٠١٧) and concluded that it is a necessary variable. Although the TAM model has received significant support for its analytical ability, it was criticized for its parsimony and lack of additional variables (Teo et al., ٢٠١٨). In this study, researchers extended TAM formulated by Davis (١٩٨٩) to include additional constructs such as perceived enjoyment (PE) to further insight into user acceptance in a specific learning context.

Perceived Enjoyment (PE)

PE is defined as "the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated" (Davis et al., ١٩٩٢, p. ١١١٣). Seeking pleasurable and joyful experiences is recognized as a basic personal desire. In the TAM٣, an extension of the original TAM by Venkatesh and Bala (٢٠٠٨), PE has been found to influence PEoU. Thus, PE would be a vital determinant of the users' acceptance and use of AR (Haugstvedt & Krogstie, ٢٠١٢; Leue et al., ٢٠١٤). Several studies have found PE to be a robust determinant that is associated with PU and PEoU in explaining the intention to use a technology (i.e., Lin & Chen, ٢٠١٧; Munir & Ilyas, ٢٠١٧; Venkatesh & Bala, ٢٠٠٨). Other works, such as Suki and Suki (٢٠١١) and Teo and Noyes (٢٠١١), proved that PE has a positive influence on ATU and ITU (Balog & Pribeanu, ٢٠١٠); therefore, it needs

to be taken into account in Davis's (١٩٨٩) TAM. As far as we know, there is no acceptance model reported for AR in KSA. This study extended Davis's (١٩٨٩) TAM by including PE to provide further insight into secondary school teachers' acceptance in AR.

Research Hypotheses

Based on previous literature research, the author formulated the following hypotheses:

H١.PEoU positively affects PU of an AR.

H٢.PEoU positively affects PE of an AR.

H٣.PEoU positively affects ATU of an AR.

H٤.PU positively affects PE of an AR.

H٥.PU positively affects ATU of an AR.

H٦.PU positively affects ITU of an AR.

H٧.PE positively affects ATU of an AR.

H٨.ATU positively affects ITU of an AR.

Methodology

Participants

To test the research model, ٢٣٢ questionnaires were distributed in ١٤ central city boys' public secondary schools in Abha City, Asir Province, KSA, in session two, ٢٠١٩/٢٠٢٠. Two hundred and nine participants responded to the survey. Returned questionnaires with incomplete or invalid answers were eliminated, and ١٨٨ (٨١ %) valid responses were collected—the relevant to the respondents' characteristics as shown and analyzed by statistical frequency and percentage. The information received from data indicated that more than half of the participants (٦٤ %) had mobile devices experience for more than ten years, which is indicative of the prevalence of using mobile devices among teachers. Concerning age, most of our subjects were between ٢٥ and ٣٤ years old (٤٢,٦٪), and about ٣٧,٢ % of them did not have experience in using an AR .

Instrumentation

The instrument was developed based on the objectives of the study and a previous literature review. Content validity was checked by pilot

testing the instrument with ٢٠ teachers selected from secondary schools. An online questionnaire—as the data collection technique—was used for this study. The respondents were able to complete the questionnaire at any time; it was expected to take about ٥-١٠ minutes for each participant to complete the questionnaire. The online questionnaire was divided into two parts. Part I of the online questionnaire was designed to identify the respondents' demographic attributes, such as their age, their experience of mobile devices and their knowledge of using AR technology in education, Internet connectivity, their experience of mobile devices, and their knowledge of using AR technology in education .

In Part II, participants were asked to fill in a ٢٤-item questionnaire. All questions were made based on Davis's previous studies with modifications in wording to fit the specific context of AR. To ensure the scales' content validity, the items selected must represent the concept about which generalizations are to be made. The scales for perceived usefulness (٦ items; α = ٠,٩١٩), perceived ease of use (٧ items; α=٠,٨٦٧), attitude toward using (٣ items; α = ٠,٨٩٩), and intention to use (٣ items; α = ٠,٨٦٧), were adapted from Davis' studies (١٩٨٩), which established their reliability and validity. The items for the perceived enjoyment construct (٥ items; α = ٠,٩٠٥) were adapted from Cabero-Almenara et al. (٢٠١٩) and Venkatesh and Bala (٢٠٠٨). This study adopted the structure of the ٥-Point Likert measurement questionnaire. Each item was given a ٥-point scale with anchors ranging from "strongly disagree" to "strongly agree". The items were modified to make them relevant to the AR context. Pretesting of the measures was conducted by users and experts selected from the educational technology field. Accordingly, the items were further adjusted to make their wording as precise as possible. The raw data collected via SurveyMonkey data were organized and automatically downloaded to SPSS® software for analysis (see Appendix A).

Statistical procedure

Statistical Package for Social Science (SPSS) software version ٢٢ was used. Descriptive and inferential statistics were applied to compute mean, standard deviation, frequency, Cronbach's coefficient alpha, correlation coefficient, and regression analysis. A significant alpha of ٠,٠٥ was adopted.

Results

Reliability analysis

According to the literature, Cronbach's alpha (α) values higher than.٧٠ are considered sufficient to conclude that a scale exhibits internal consistency reliability (Gliem & Gliem, ٢٠٠٣). Using the scale function of the SPSS software, the Cronbach's α scores, ranging from ٠ to ١, were computed for each variable. The reliability analysis results in this study indicate Cronbach's α is.٩٥٩ >.٧٠ for the statements, which indicates a high level of internal consistency. Cronbach's α for all variables is between.٨٦٧ and.٩١٩. Consequently, the scores derived from the survey were deemed reliable as in Table ١in the Statistical Appendix B.

Descriptive Statistics: Constructs and Items

Descriptive statistics showed that among five constructs, ITU earned the highest scale score (M= ٤,٣٦ , SD =.٦٠٧) of the constructs in the model, and the mean was similar to the mean score for ATU (M = ٤,٣١, SD =.٦٠٧), with PE (M=٤,٢٨, SD =.٥٩), and PU (M = ٤,٢٧, SD =.٦٠٤), while PEoU (M= ٤,٠٥, SD= ٦٠٦) had the lowest rating. Further, Table ٢ in the Statistical Appendix B specified that the individual survey items with the top six highest agreement scores were all from either the ITU-" I predict I would use AR for learning in the future" (M = ٤,٣٦٦٧, SD =.٦١٥٤٤); "I intend to use AR when it becomes available in my school" (M = ٤,٣٦١١, SD =.٧١٥٠٧); "If available, I plan to use AR in the future" (M = ٤,٣٥٥٦,SD =.٧١٣٩٦); PE- "Using AR in education is pleasurable (M = ٤,٣١٧١, SD =.٦٨٩٥٩); PU-" I would find AR useful in my teaching"(M = ٤,٣١٥٨, SD =.٦٣٦٨٥); PEoU- "I feel that using AR would be easy for me" (M= ٤,٢٢٨٩, SD =.٧٠١٩٥) .

The three individual items that received the lowest agreement scores were all from the construct of perceived ease-of-use (PEoU): "I feel that my ability to determine AR ease of use is limited by my lack of experience." (M = ٣,٦٦٨٧, SD = ١,٠٩٢٠٦); "Interacting with AR is unambiguous and easy to understand." (M = ٤,٠٦٠٢, SD =.٨٠٦٧٨); "Learning to operate AR would be easy for me" (M = ٤,١٣٨٦, SD =.٧٤٥٩٥).

Correlation Analysis

The correlation refers to a technique for analyzing relationships between variables and assessing whether the correlation between them is statistically significant. A correlation is statistically significant if its “Sig. (٢-tailed)” < ٠,٠٠١. Each correlation is computed on a slightly different N -ranging from ١٦٤ to١٨٠. This is because SPSS uses pairwise deletion of missing values by default for correlations. The widely used rules specified by Cohen (١٩٨٨) regard a correlation of r =.١٠ as small, r =.٣٠ as moderate, and r =.٥٠ or larger as strong or large correlation .

Pearson’s correlation was computed to assess the relationship between all research variables. As depicted in Table ٣ in the Statistical Appendix B, all constructs —PU, PEoU, PE, ATU and ITU—are significantly correlated (p<.٠٠١). They all scored higher than ٠,٦, and no correlation was above ٠,٨. This confirms the original hypothesis made in the literature concerning the TAM model. The results indicated a significant positive correlation between PEoU and PU, r = ٠,٦٧٢, N =١٦٦, p<.٠٠١, supports hypothesis H١. Increases in PEoU were correlated with increases in teachers' PU of AR in their future teaching practice .

PEoU and PE were significantly positively and strongly correlated, r = ٠. ٧٣٦, N =١٦٤, p<.٠٠١, and supported hypothesis H٢. The hypothesis H٣ was also supported by a significant positive correlation between PEoU and ATU, r = ٠,٦٧٤, N = ١٦٤, p<.٠٠١. Further, the results indicated a significant positive association between PU and PE, r =.٧٣٥, N =١٦٤, p<.٠٠١, supports hypothesis H٤. From the Correlations table, it can be seen that the variables PU and ATU were significantly and strongly positively correlated r =.٧٦١, N = ١٧١, p<.٠٠١, in which this analysis gave support to hypothesis H٥, and PU is strongly related to ITU, r =.٧٦١, p< ٠,٠٠١, supports hypothesis H٦. Besides, a high value of correlation found between ATU and PE, r =.٧٧٣, N=١٦٤, p< ٠,٠٠١, supports hypothesis H٧. The variables ATU and ITU were significantly and strongly positively correlated, r =.٦٦٠, N = ١٦٤, p<.٠٠١, supports hypothesis H٨ .

Structural Model Testing Results

The next step in data analysis was to examine the significance and strength of hypothesized relationships in the research model (Fig.١). Thus,

regression analysis was conducted to test the hypothesis relationship between independent variables and dependent variables. Fig. ٢ illustrated the graphical presentation of the β-value for each of the variables. Further, Table ٨ shows the overall results.

Regression Analysis of PEoU and PU.

The results indicated that the value of R^2 is.٤٥٢, which indicates that ٤٥٪ of the variance of PEoU is accounted for the model. PEoU had a strong influence on PU (β=.٦٧٢, t= ١١,٦٢٢). The value of F= ١٣٥,٠٧٨, p<.٠٠١, means there is a positive relationship between variables. The value B for PU=.٦٧٣, p<.٠٠١, indicates that an increase in the PU of AR will lead to an increasing PEoU, in which this analysis gave support to Hypotheses١ (see Table ٤ in the Statistical Appendix B).

Regression Analysis of PEoU and PU vs PE

As depicted in Table ٥ in the Statistical Appendix B, the value of R^2 is.٦٥ which indicates that this model accounts for almost ٦٥٪ of the total variation in the data. Thus, both PEoU and PU significantly influence PE [F (٢,١٦١) = ١٤٧,٩٩٩, p <.٠٠١], supports hypothesis H^2 and H٤. PEoU (β =.٤٤٢, p<٠,٠٠١) has slightly stronger effects on PE compared to PU (β =.٤٣٩, p<٠,٠٠١).

Regression Analysis of PEoU, PU and PE vs ATU

The results indicated that the value of R^2 is ٠,٦٨٥, indicating that this model accounts for almost ٦٩٪ of the total variation in the data. Both PU and PE had a significant positive relationship with ATU (β =.٣٨٦, t= ٥,٦٦٢, p<٠,٠٠١; β =.٤٠٠, t= ٥,٣٤٢, p<٠,٠٠١) respectively, this mean there was a positive relationship between variables, which gave support to hypotheses H^5 and H^7. However, PEoU had no significant positive relationship with the construct of teachers' attitude (β =.١٢٢, p > ٠,٠٥), and thus hypothesis H^3 is not supported (see Table ٦ in the Statistical Appendix B).

Regression Analysis of PU and ATU vs ITU

A significant regression equation was found [F (٢,١٣) = ٨٠,٠٤٧, p <.٠٠١], with an R^2 of.٤٩٩, taken as asset, the predictors —ATU and PU —and accounted for ٥٠ % of variance in ITU, which is very good in practice. Table ٧ in the Statistical Appendix B reveals that PU (β=.٣٨٨, t-

value = ٤,٥٠٩, p <.٠٠١), and ATU (β =.٣٦٤, t-value= ٤,٢٣٦ , p <.٠٠١) have a positive relationship with intention to use (ITU) and are statistically significant predictors. Thus, as PU, (β =٠,٣٨٨) increases by one ٠,٦٠١٨ SD, ITU will increase by ٠,٢٤٨ of a scale point (٠,٣٨٨ x ٠,٦٠١٨ ITU.SD); as ATU (β = ٠,٣٦٤) increases by one SD ٠,٦٠٧, ITU will increase by ٠,٢١٩ (٠,٣٦١x ٠,٦٠٧ SD). So, H٦ and H٨ were supported.

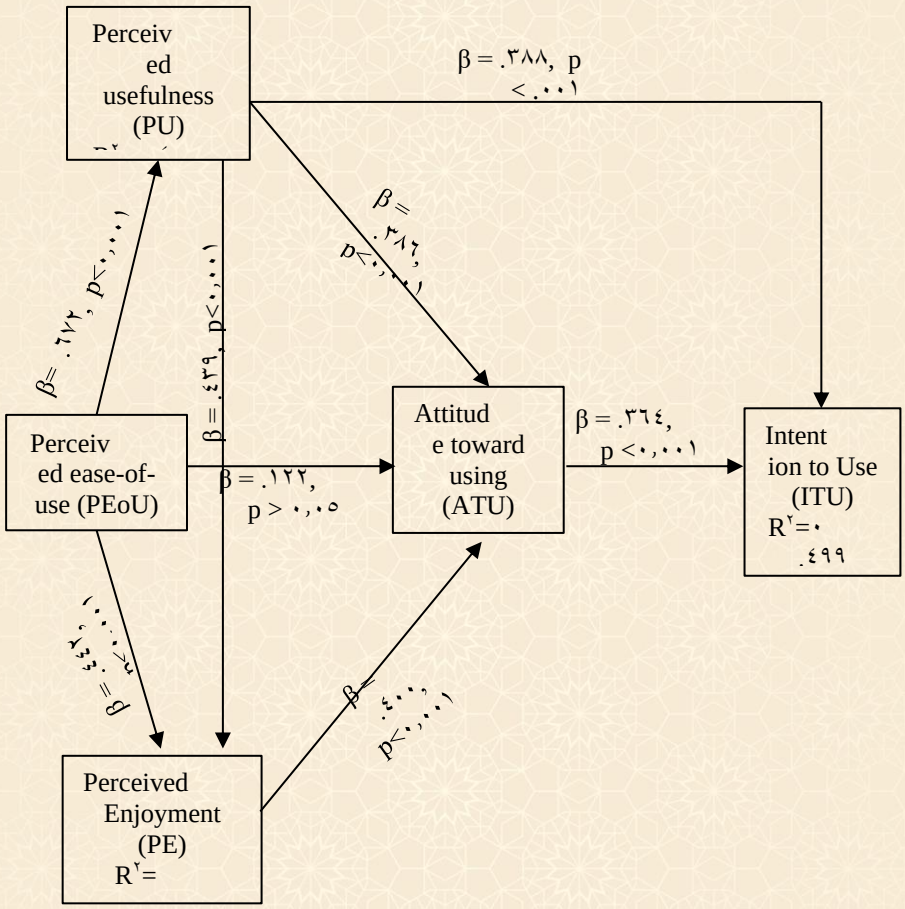

Figure ٢: Model testing results

Discussion and Conclusion

This study aimed to extend Davis's (١٩٨٩) TAM by incorporating perceived enjoyment (PE) to the model to explore the extent to which these variables affect teachers' perceived intention to adopt and use AR. Before proceeding to statistical analysis, the reliability of the survey was computed using

Table ٨
Summary of Hypothesis Testing Results

Hypothesis	Proposed relationship	Test Result	Conclusion
H_1	PEoU — PU	*β= .672, p<0.001***	Supported
H_2	PEoU — PE	*β =.442, p<0.001****	Supported
H_3	PEoU— ATU	*β =.122, p > 0.05*	Not Supported
H_4	PU — PE	*β =.439, p<0.001****	Supported
H_5	PU— ATU	*β =.386, p<0.001****	Supported
H_6	PU — ITU	*β =.388, p <.001****	Supported
H_7	PE — ATU	*β =.400, p<0.001****	Supported
H_8	ATU — ITU	*β =.364, p <0.001****	Supported

Note: *** p<٠,٠٠١; not-significant p > ٠,٠٥. Intention to Use=ITU, Attitude Toward Using= ATU, Intention to Use=ITU, , Perceived Ease of Use= PEOU, Perceived Usefulness =PU, Perceived Enjoyment=PE.

Cronbach's α. According to the results, all constructs have acceptable validity and reliability. Assumptions regarding the regression analysis were also checked graphically. The results concluded that the data of this study had satisfied all the assumptions for regression analysis. The proposed research model was designed to explore whether teachers are willing to adopt AR in their future teaching practice or not. Similar to previous studies (Akçayır & Akçayır, ٢٠١٧; Cabero-Almenara et al., ٢٠١٩; Ibili et al., ٢٠١٩), the results of the present research supported theoretically and empirically the ability of the Davis's (١٩٨٩) TAM to be

a suitable theoretical framework for better understanding the teacher's acceptance of AR.

All hypotheses except hypothesis H٣ were accepted at the ٠,٠٥ level of significance. The results revealed the positive direct effect of PEoU on PU, which is aligned with previous studies (Chuah et al., ٢٠١٦; Iba'nez et al., ٢٠١٦; İbili, ٢٠١٩; Nikou & Economides, ٢٠١٧). This research suggests that PEoU is essential to teachers' acceptance and intention to use AR for teaching. The researcher found that when AR is easy to use, teachers feel it is useful; therefore, they will have stronger intentions to use AR in their future teaching practice. Likewise, in agreement with the results of Chuah et al. (٢٠١٦) and Haugstvedt and Krogstie (٢٠١٢), both PEoU and PU significantly influence PE. The results indicated that teachers' PEoU has stronger effects on PE than PU. Furthermore, the study identifies that both PU and PE are related to ATU, which is consistent with findings from Sánchez-Prieto et al., (٢٠١٧), Revythi and Tselios (٢٠١٩), and with Wu and Chen (٢٠١٧).

Unlike previous TAM studies conducted by Davis (١٩٨٩), Huang (٢٠١٦), Iba'nez et al. (٢٠١٦), Šumak et al. (٢٠١١), and Luan and Teo (٢٠٠٩) who provided evidence of the impact of PEoU on ATU, the findings obtained from the present study indicated that there is no significant effect of PEoU on ATU. A plausible reason for the lack of support for H٣ is that the teachers in the present study may not see PEoU as a critical factor that will not put much effort into making use of AR in their future teaching practice. Moreover, the results are in accordance with Sánchez-Prieto et al. (٢٠١٧), Revythi and Tselios (٢٠١٩), and Wu and Chen (٢٠١٧) regarding the significant influence of PU and ATU on ITU. The current study contributes to the validation of the extended TAM model by introducing and confirming PE's influence on users' attitudes and intentions to use AR. Further, the present study, along with previous studies, has proved the contribution of AR in education; however, research on this topic is still in an early stage, particularly in the educational context of KSA.

Implications for Practice

Educational organizations can benefit from the findings of the current study as it displays the first findings of secondary school teachers' perceptions regarding AR within the context of education. The general

structural model enhances our understanding of teachers' intention of using AR. This understanding can help our efforts when promoting AR. Educational providers should also endeavor to increase teachers' positive attitudes toward AR. Students are bored with traditional learning methods. AR is a technology that overlays interactive digital elements into real-world environments. Applications of AR in education are becoming more and more sophisticated and can make up for the limitations of these methods. As teachers, in the current study, considered AR applications can make learning more efficient, fast, and much more enjoyable, schools, teachers, and educational institutions should adopt such applications in the classroom to motivate students to participate in enjoyable activities and create different learning experiences. Teachers could utilize AR applications to enrich their students' knowledge and understanding with immersive virtual experiments on topics. For instance, a chemistry teacher could enhance students to utilize a library of virtual chemistry experiments to learn and understand without the hazards. Teachers should be encouraged to gain more experience to apply such applications in their classrooms.

Limitations and Future Research

Study Limitations

Although rigorous research procedures were implemented, this study has limitations that could be addressed in future studies. First, this study focused only on male secondary school teachers. Second, the participants completed an Arabic language version of Davis's (١٩٨٩) TAM survey, which was backtranslated into English language, so a level of accuracy may have been conceded to some degree in this language conversion process. Third, there may be other individual and technology variables that may affect the intention to use AR technology. Lastly, the variable actual use behaviors were not included in the present AR model.

Future Research

The area of AR is still an immature field and needs further research to understand the determinants of AR using technology acceptance theories and models. Several opportunities are available to extend this research. Further research should be conducted at other educational institutions in KSA that could add to generalizability. Besides, a study that

extends globally to other countries' higher education institutions is valuable because attitudes and adoption behaviors of AR in other cultural contexts differ from those in KSA. Besides, a research study should examine AR acceptance among students and instructors, particularly in cultural and educational settings that emulate a context such as KSA. Future research can incorporate other variables into the research model.

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Abstract (٤)

This study aimed to investigate teachers' behavioral intention to adopt and use augmented reality (AR) in Saudi Arabia. Based on the Technology Acceptance Model (TAM), a sample of ١٨٨ secondary school teachers from ١٤ central city boys' public secondary schools in Abha City, participated in the study. A composite model including five constructs, namely, perceived usefulness, ease of use, attitudes towards use, intention to use, and perceived enjoyment, was formed and tested. The study results confirmed the acceptability of the model to explain teachers' acceptance of AR. Further, the results pointed out that the intention to use AR is determined by perceived usefulness and attitude towards using, were structured elements of AR. It is also shown that the teachers' attitudes towards using AR is determined by perceived usefulness and perceived enjoyment but is not determined by perceived ease-of-use. In the past, there were few AR-related studies that investigated the relationships between the construct of perceived enjoyment and other constructs in Davis's (١٩٨٩) TAM. Thus, the findings in the present study provide a reference for future TAM and AR-related studies. Implications for teachers and researchers were established from the findings. In the context of AR, some suggestions to improve current practice were also suggested.

Keywords: Davis's (١٩٨٩) TAM, augmented reality, secondary school.

Examining Saudi's Secondary School Teachers' Acceptance of Augmented Reality Technology

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