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A REVIEW OF RECENT METHODOLOGIES, TECHNOLOGIES AND USABILITY IN ENGLISH LANGUAGE CONTENT DELIVERY

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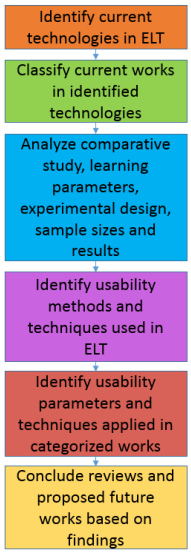
Graphical abstract



Abstract

English Language Teaching (ELT) and content delivery have undergone vast shift in this era of modernization. With analogue content digitized as a common form of knowledge delivery, methodologies equipped with current technologies have produced new perspectives on English Language Learning. This paper reviews the status, context, teaching parameters, assessment parameters, teaching strategies and usability in the current research capacity of ELT, highlighting the current works with technologies in their content delivery methods. Emerging technologies in ELT has also inspires the other spectrum of study involving the usability of technological interfaces, which has evolved constantly with the progression of human and computer interactivity. The aim of this research is to rediscover usability evolution surrounding the technologies in ELT and to redefine the gap existed in between English learning and tools interactivity. Current technologies and usability measures used in ELT will be discussed, highlighting the current trends in gauging interface interaction. A summary of comparative results in the aforementioned works will also be highlighted in this review paper, together with the categorization of reviewed parameters, variables and metrics in ELT. The reviews conducted have shown that there are still many unexplored areas in ELT, ELT technologies and usability in ELT.

Keywords: English language teaching; augmented reality; mobile learning; augmented reality; mobile learning; usability

1.0 INTRODUCTION

English Language Teaching (ELT) has always been debated in the milieu of methodologies, pedagogies and deliverance. Being one of the major languages in the world and spoken as a substitute language in 44 non -English speaking countries [1], English language learning has evolved through different phases of refinement and approaches. In a rapid pace and multiple branches of ongoing improvements, several research questions arise demanding for details on the status and current methodologies used in English Language Teaching. With vast transition from traditional classroom learning setup to digitized content delivery, ELT has progressed into a new dimension of teaching methodology. From self-learning through Graphical User Interface (GUI), to the tangible approaches such as Augmented Reality (AR) and the ease of ubiquitous mobile-learning, ELT adopts assimilation of current

arrays of technologies to improve several learning metrics imaginable. The knowledge of these current methodologies using current technologies is therefore crucial within the ELT academic research area.

The aim of this review is to critically find possible gaps in the research involving ELT, the types of delivery technologies and usability involved in measuring the criteria of an effective ELT approach. This paper reviews the current work in all three research domains to find the possible co-relation and gaps.

2.0 METHODOLOGY

This section covers the methods commonly used in English Language Teaching (ELT), current technologies used in objectified to comprehend the published comparative results and usability measures used in each reviewed items.

2.1 English Language Teaching

According to Yamat, Fisher and Rich in [2], English Language Teaching or ELT is stipulated in the curriculum to equip students with the basic English language skills (listening, speaking, reading and writing) and knowledge of grammar to enable them to communicate (orally and in writing) in and out of school for different purposes [1]. English can be taught in the context of ESL (English as a Second Language), EAL (English as Another Language) or EFL (English as a Foreign Language) [2]. Malaysia applies ESL in the ELT syllabus but the standardized examinations focus on accuracy in the literacy skills - reading and writing as reflected by the structured examination questions, rather than speaking and listening. From the perspective of other countries where English is not the primary language, ELT has also been taught as a second language (ESL) or foreign language (EFL) in Taiwan [3][4][5], EFL in Turkey [6], EFL in China [7] and ESL in The Netherlands [8].

2.2 Current Technologies Used in English Language Teaching

Learning English has always evolved through different trends in methods, approaches and technology. Since English has been the most important second language in non-English speaking countries, developing modern assistive learning forms or tools that support effective English learning has been a crucial issue in the English-language education field [9]. Technological trends have been influential to knowledge deliverance over time with ongoing innovation in Information and Communication Technology (ICT). These trends have led to learning forms changing from traditional classroom learning to electronic learning (e-learning), mobile learning (M-learning) or ubiquitous learning (u-learning) [3]. Figure 1 shows the evolution of learning in the context of ELT.

The advancement of technology has given teachers the opportunity to boost the teaching and learning of English language where it is believed that the integration of ICT could enhance the quality of teaching and make learning more effective [10]. However, in a study conducted by [10], it was reported that majority of the teachers have positive views about the integration of ICT in teaching English However teachers are utilizing ICT equipment for certain tasks only such as to find information and to prepare PowerPoint presentations. They do not have much exposure about other opportunities provided by ICT, which leads to the lack of integration of ICT in the teaching of English language in secondary schools [10] in Malaysia. This scenario might provide the explanation to why studies on the use of technology in ELT was not as many as compared to other nations. The next section will discuss more on technological advancement in education and work which has been done specifically in ELT. This section will discuss in detail the currents work and models done in all the 3 e-learning paradigm namely augmented reality learning (AR-learning), mobile learning (M-learning) and mobile augmented reality learning (MAR-learning).

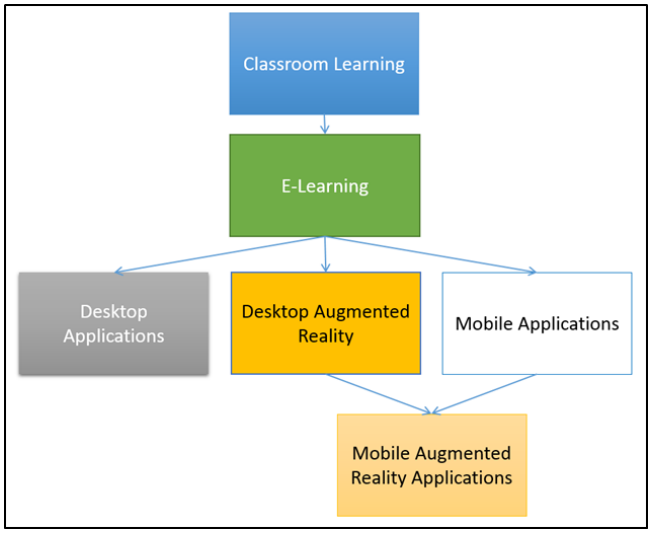


Figure 1 Evolution of technology in the context of English Language Teaching

2.2.1 Augmented Reality Learning (AR-learning)

Augmented Reality Learning (AR-learning), is associated with tangible user interface interactions styles As the name suggests it is the augmentation of reality with digital content and information in real time setup. In a study carried out by Lee in [11], Augmented Reality (AR) is a technology that allows computer-generated virtual imagery information to be overlaid onto a live direct or indirect real-world environment in real time [12] [13]. In the learning and education domain, augmented reality learning (AR-learning) has been widely used, studied and tested as a technology that enhances learning effectively and efficiently

based on many positive results. Since interactions used are mostly tangible, AR technologies can be designed to interact through many sensory channels (e.g. auditory, visual, olfactory, and haptic), which render definitions focused only on visual data insufficient to deal with future developments in AR [14]. The different interaction style compared to traditional books, writing boards, mouse and keyboard setup has afford new perspective in learning. Johnson *et al.* [15] stated, "AR has strong potential to provide both powerful contextual, on-site learning experiences and serendipitous exploration and discovery of the connected nature of information in the real world." Yuen, Yaoyuneyong and Johnson [14] highlighted education directions in AR, with implementation through AR Books (which is considered a major stepping stone helping the public bridge the gap between the digital and physical world), AR Gaming, Discovery-based Learning, Objects Modeling and Skills Training. Furthermore, AR has the potential to engage, stimulate and motivate students to explore materials from different angles [14].

Lee [11] mentioned that the technologies that make AR possible are much more powerful than ever before and compact enough to deliver AR experiences to not only corporate settings but also academic venues through personal computers and mobile devices. In the field of ELT ESL, EFL and EAL, Vate-U-Lan in their study on 37 Grade Three students in Thailand have reported students' preference on using an Augmented Reality 3D pop-up book in the hybrid mode of learning English compared to Virtual Reality (VR) (Figure 2) [16].

Figure 2 Augmented Reality 3D Pop- up Book [16]

Chang *et al.* [17] on the other hand performed a test on 109 English learners using AR in vocabulary learning. From the experiment, Chang *et al.* found that AR attracted learners' attention while learning, thus enhancing effectiveness [17]. However, the use of the marker in the experimental setup decreases learner's enthusiasm to use AR in vocabulary learning (Figure 3) [17].

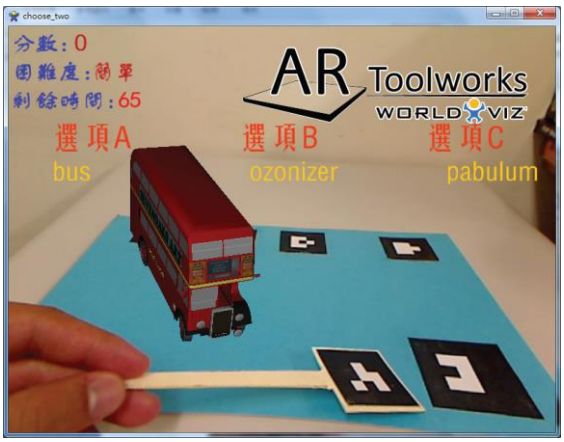


Figure 3 The operation and display of the AR-learning system for vocabulary examination [17]

In another work on AR English learning, Barreira *et al.* [18] introduce MOW (Matching Objects and Words) as an educational AR game developed in collaboration with elementary school teachers. MOW allows children to learn a variety of words in both Portuguese and English languages (Figure 4). The results indicate that children who used the AR game had a superior English learning progress than those who only used traditional methods. The experiment was conducted on 26 children aged 7 to 9. They were divided into two groups: one group used AR technology and the other group used only traditional teaching methods [18].

Figure 4 Children playing with MOW in English class [18]

The usage of AR in ELT seems to be something refreshing. Despite the positive reports by researchers, there are still several issues that have not been addressed. The effectiveness of learning using AR was mostly gauged through user satisfaction measure and rarely through performance. Furthermore, the AR studies done in ELT seems limited compared to traditional e-learning and M-learning maybe due to current challenges, complexity of physical learning setups which will also require additional interface training on both educator and student [19].

2.2.2 Mobile Learning (M-learning)

Korocu and Alkan [20] define Mobile Learning (M-learning) as a distance learning model which is designed to meet educational needs with the help of mobile devices. With the fast growing web community to be mobile users, the development of educational technologies in recent years has tended to be mobilized, portableand personalized [3]. M-learning is also a form of educational model which can be very beneficial for students as it provides learners the opportunity for education independent of time and environment. [20]. Although e-learning has much more advantages than traditional education methods, some of its shortcomings have led the science world to new pursuits such as the development of mobile Technologies and the need for movement of the technology in education to new dimensions have reslised the new notion M-learning [20]. Coining M-learning as here and now learning, Martin and Ertzberger introduce a framework explaining M-learning through three principles: engaging, authentic and informal [21]. More and more scholars believe that M-learning will be beneficial through learning anywhere and anytime in future education [22] [23] [24] [25] [26]. Mobility and spontaneity that mobile devices offer are observed in the present study. With these two features, mobile participants could engage themselves in reading online material ubiquitously, either on or off campus [5].

In the context of ELT, several works have been done in M-learning especially for ESL, EFL and EAL. Since M-learning provides the learning flexibility compared to traditional learning, Self-Management Learning (SML) is often related to the nature of independence within M-learning. Huang [27] has done work related to SML to improve mobile learning designs in ELT. In an experiment using mobile-assisted learning on 116 students, Liu and Chen discover that those who learned English phrases through mobile photo taking significantly outperformed those who learned through common learning methods [4].

Sandberg, Maris and de Geus on the other hand have performed a study on 85 fifth-graders who were separated into three different groups in English reading and writing [8]. The findings [8] show that the group engaged in M-learning combined with SML outperformed the group engaged with only M-learning and the group learning English only through class lessons (Figure 5). On the other hand, Lin [5] conducted an experiment on the reading skills performance of 84 tenth-graders through M-learning and desktop learning approach using the Extensive Reading Programs (ERPs) in English.

The findings presented empirical evidences that students exposed to the integration of M-learning into ERPs outperformed and outscored those using desktop e-learning both linguistically and affectively (Figure 6) [5]. From the context of tourism, Hsu and Lee [28] confirm the benefits of M-learning on English vocabulary retention and grammar learning. Based on their study on 50 participants, the results showed that participants using M-learning approach appreciate the experience more than those who participated in traditional classroom setup. Chen and Chung in their studies found that personalized mobile English vocabulary learning system can significantly enhance learners' English vocabulary abilities and promote learning interests [3]. Performing tests on 15 students, results also demonstrated that most learners believe the review strategy is very helpful when learning English vocabulary [3].

Figure 5 Experiment on M-learning and SML [8]

Figure 6 Raz-Kids [5]

2.2.3 Mobile Augmented Reality Learning (MAR-learning)

Mobile Augmented Reality Learning (MAR-learning) is the latest technology combining the mobile criteria of M-learning and visualization effectiveness of AR-learning. According to Lee [11], wireless mobile devices, such as smart phones, tablet PCs, and other electronic innovations, are increasingly ushering AR into the mobile space where applications offer a great deal of promise, especially in education and training. However, little research has been conducted using MAR-learning in ELT.

In the works of Liu for example, he has explored the combination of AR M-learning and ubiquitous (U-learning) in an English learning environment named HELLO (Handheld English Language Learning Organization) [29]. In an experiment done on three teachers and 64 seventh grade students to compare

HELLO and traditional learning methods, Liu found that students using HELLO performed better in listening and speaking (Figure 7) [29].

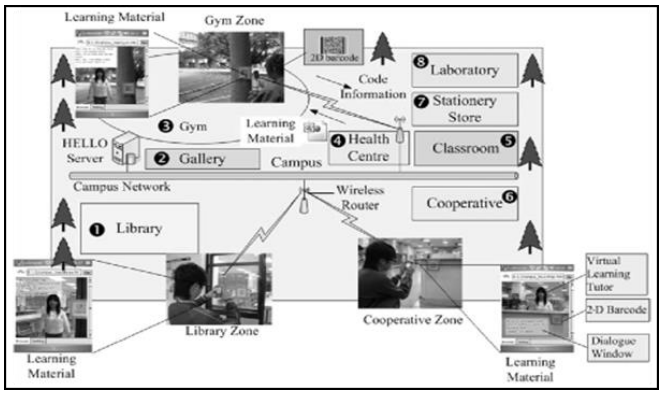


Figure 7 HELLO U-learning activities [29]

Liu and Tsai [30] applied global positioning and AR Techniques in mobile assisted English Learning in their study. In an experiment involving 5 undergraduate participants, they discovered that mobile AR assisted the participants with English vocabulary and expressions needed for descriptive writing (Figure 8) [30]. He et al [7] used AR technology to design and develop mobile-based English ELT software. In an experiment involving 40 pre-school children, He et al concluded that mobile-based AR learning software is helpful to students who are non-native speakers for learning vocabulary (Figure 9) [7].

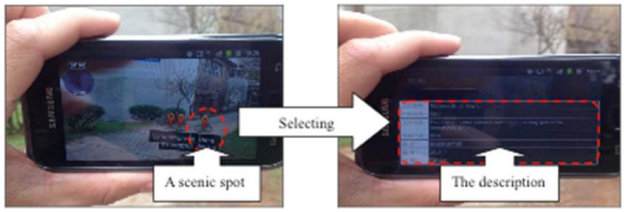


Figure 8 Using the augmented-reality-based mobile learning material [30]

Figure 9 Students are studying words using the mobile- based AR application (He *et al.*, 2014)

Other studies related to mobile AR include scholarly works in general education. Fitzgerald et al suggested taxonomy of classifying AR in mobile environment, which can be used to categorize different research aspects in mobile learning [31]. However, despite many positive feedbacks from mobile AR studies, there are still many challenges and research gaps to be explored. There are two major areas, highlighted by Fitzgerald et al in mobile AR, namely technical challenges and pedagogical challenges [31]. Pedagogical challenges highlight interesting facts where studies have shown conflicts between technology experience or learning experience, which renders learning objectives are altered to fit around an AR device limitations [31]. Furthermore many results from the above mentioned studies did not highlight clearly or at least normalize biases on a technological "wow" factor which makes learning experience engaging and interesting, but not the content of the knowledge itself. Beauchamp and Parkinson in [32] explain "wow" factor where they described how students might be interested and curious in something new and unfamiliar at first, but will revert to less attentive behavior once the "wow" factor has passed. Murray and Barnes on the other hand maintain that the "wow" factor encompasses both extremely positive and extremely negative initial reactions in the user towards a software package [33]. This immediate, instinctive evaluation can color the user's opinion of the program as a whole, even on a medium- to long-term basis [33]. If "wow" factor is what was actually achieved through the learning experience, then the intention might probably defeat the whole objective of the knowledge content in the first place.

As far as mobile AR device is concerned, a study by Furió et al shows that there are still limited number of research addressing the issues of comfortability in mobile devices' handling and operation [34]. As one of the pioneers looking into this field, Furió et al shows in his study on seventy-nine 8 to 10 year old children, that there are no significant differences in performance and user satisfaction when operating devices with different screen size and weight [34]. However, there might be many more research loopholes to look into especially on children's demography, prior experience with mobile devices and physical ability.

3.0 RESULTS AND DISCUSSION

This section discussed the categorization of the reviewed learning technologies, the respective published results and usability measures used to achieve the reported results of each study.

3.1 Categorization of the Elements Of English Language Teaching

The emergence of AR-learning, M-learning and MAR-learning has created a wide domain in the use of technology in ELT. Besides focusing on different ELT

contexts, these technologies have so far been able to address ELT knowledge and assessment parameters in a new dimension and method of delivery. These ELT elements have been derived from 9 current researches mentioned in earlier section as categorized in Figure 10. Information given in Figure 10 has been collected, analyzed and categorized. They were from different countries where English is not the first language. However, as mentioned earlier, no research of this nature has been conducted in the context of Malaysian English, Malaysian ESL and ELT. Works however has been carried out in this domain by several researchers all over the world. The details of these current researches in ELT in the three mentioned technologies have been tabulated in Table 1 for further references. Table 1 has segregated information according to the author, learning context (ESL, EFL or EAL), learning parameters, experimental design, assessment methods, sample size and the findings of the experiments carried out.

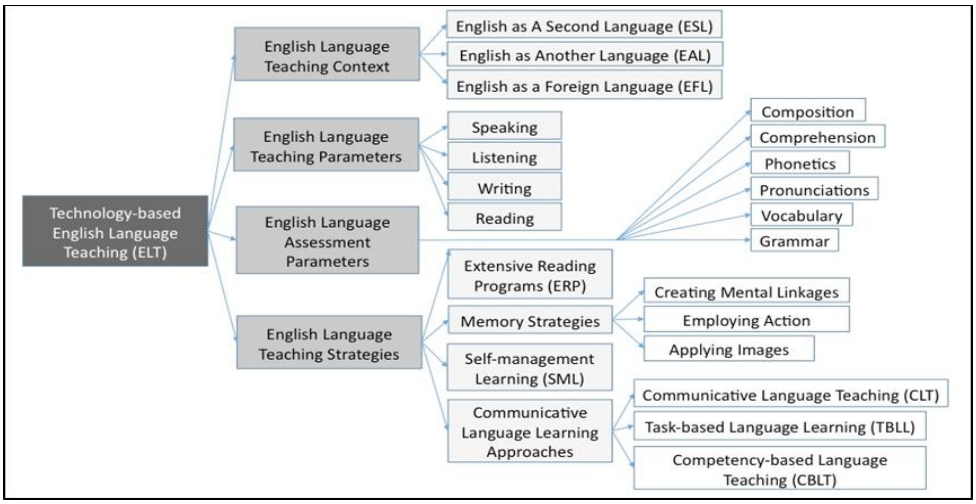


Figure 10 Categorization of ELT elements

Table 1 Current Study in English Language Teaching and Current Technologies

Author	Context	Learning Parameters	Experiment Design	Sample size	Results
He *et al.* [7]	EFL	Vocabulary and Pronunciation	MAR-learning vs. traditional learning	40 (age 4-6), 1 teacher	MAR–learning performed significantly better
Liu and Chen [4]	ESL	Phrases	M-learning (photo taking) vs. e-learning	116 college students: 2 groups	M-learning performed better in all post test
Lin [5]	EFL	Extensive Reading Programs (ERPs)	M-learning vs. e-learning	84 10th grade students in 2 classes	M-learning spend more time reading. Performed better in reading skill
Liu and Tsai [30]	EFL	Writing, vocabulary, composition	MAR-learning	5 (age 20) undergraduates	Construct knowledge and produce meaningful essays
Vate-U-Lan [16]	ESL	Comprehension	AR-learning	37 Grade 3 students	Post-test is significantly better
Barreira *et al.* [18]	EFL	Words	AR-learning vs. traditional learning	26 children aged 7-9	AR has superior learning process
Sanberg, Maris and de Geus [8]	ESL	Vocabulary	M-learning vs. take home M-learning vs. traditional learning	75 5th grader (3 different schools)	Home M-learning is significantly better than traditional learning
Hsu and Lee [28]	EFL	Vocabulary retention, grammar learning, and listening comprehension	M-learning Vs. traditional learning	50 working adults in 2 groups	M-learning scored in all parameters
Liu [29]	EFL	Listening, speaking with phonetics, vocabulary and grammar	MAR-learning vs. traditional learning	64 7th grade students, divided into 8 groups, 3 teachers	MAR-learning significantly better than traditional classroom

3.2 Usability in Diverse Technologies

The International Standards Organization (ISO 9241-11) in [35] identifies three aspects of usability, defining it as ''the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use (International Standards Organization, 1998).''

The ISO 9241-11 model (Figure 11) has been the benchmark of usability for all platforms, where efficiency and effectiveness can both be measured quantitatively, satisfaction on the hand leans more on qualitative data.

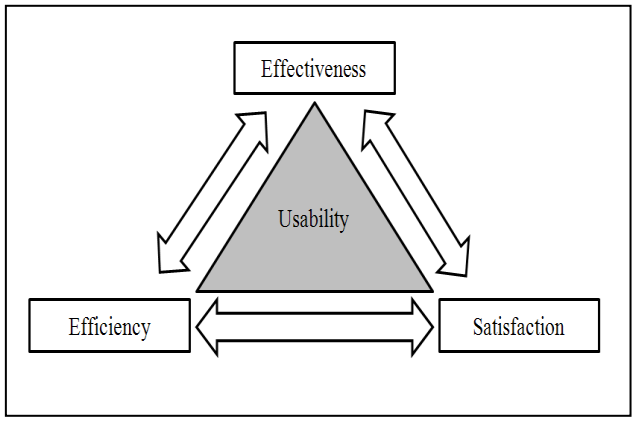


Figure 11 ISO 9241-11 Usability Model [11]

There are several researches however that relates satisfaction to quantitative measures using engagement metrics [36][37].

Dunser and Billinghurst in [38] has mentioned that evaluation approaches used in traditional Human Computer Interaction (HCI) such as the usability model are often applied to AR research, but evaluating AR systems with users sometimes requires slightly different approaches than evaluating traditional Graphical User Interface (GUI) based systems. The same scenario happens in other interfaces like M-learning and MAR-learning as well. As general as ISO 9241-11 can be, applicable to all visual displays including M-learning, AR-learning and MAR-learning, many researches has innovate usability models to suit specific and tailored technology interfaces.

Santos *et al.* in [39] for example has developed a usability scale for handheld augmented reality called Handheld Augmented Reality Usability Scale (HARUS) as an alternative to standardized questionnaire such as System Usability Scale (SUS), Technology Acceptance Model (TAM) and NASA Task Load Index (TLX), which has been widely used for other interfaces. The usage of standardized questionnaires has not been validated and verified for being suitable for newer technologies and interface such as handheld mobile AR devices. Olsson in [40] on the other hand produces a set of questionnaires comprising of summative and formative measures for mobile augmented reality applications. Huang in [27] has also developed a framework for mobile English learning which includes concept of mobile English learning satisfaction (MELS) and English learning continuance intention (MELCI), measured with Perceived usefulness (PU), Perceived playfulness (PP), resistance to change (RTC).

3.3 Usability Used in Current English Language Teaching Technologies

The current works done within AR-learning, M-learning and MAR-learning is still verifiable using usability measures. This section has particularly reviewed usability methods, techniques and parameters from 12 current research works. Summary is shown in Figure 12.

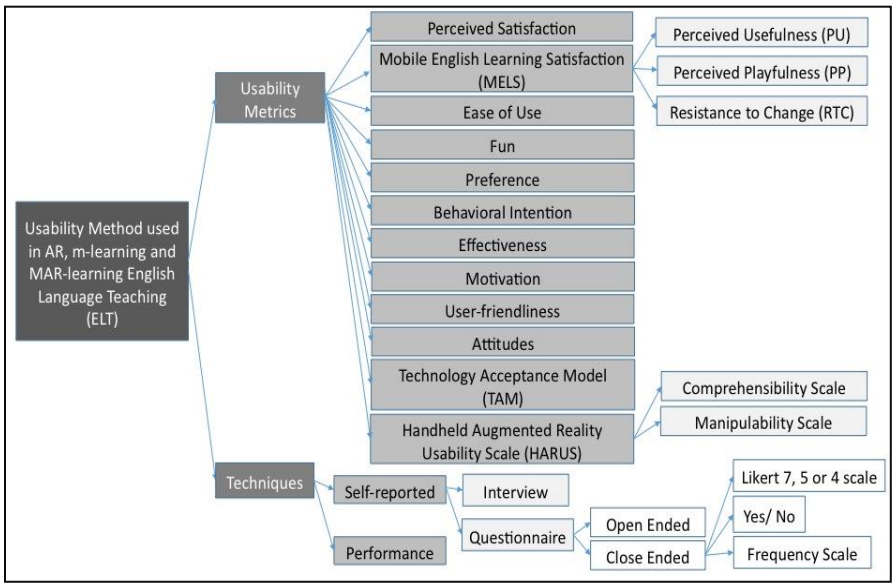


Figure 12 Metrics and techniques used by current ELT technologies

All 12 researches are done from the context of ESL, EAL and EFL with current technologies. Among the 12 research works, 3 experiments are done using AR-learning, 5 experiments using M-learning and 4 experiments using MAR-learning. All 12 researches have somehow carried out usability measurements on their samples using different methods, techniques and metrics. He *et al.* in [7] and Liu in [29] have been collecting their data qualitatively using interview techniques for post- experimental experience. Researches like Huang in [27], Barreira *et al.* in [18], and Hsu and Lee in [28] on the other hand have been using questionnaires technique with Likert 5 point scales to achieve quantifiable subjective measures. Sanberg, Maris and de Geus in [8] contrary has chosen Likert 4 points for their questionnaire with some ipsative touch to the rigidity of the questions. Works done by Liu and Chen in [4], Liu and Tsai in [30] uses standard open and close ended questionnaires. As for experiment done by Lin in [5], Chang *et al.* [17] and Liu, Tan and Chu in [41], Technology Acceptance Model (TAM) questionnaires have been used perhaps due to the verified components within the model itself. Most metrics used in these current works is listed and categorized in Figure 12. A detailed description on each experiment mentioned in this section is recorded in Table 2.

Table 2 Usability parameters and techniques used in current ELT

Author	Context	Technology	Usability Parameters	Usability Techniques
He *et al.* [7]	EFL	MAR-learning	Perceived satisfaction	Interview
Huang [27]	SML, ESL	M-learning	Satisfaction: PU, PP, RTC, MELS, MELCI	Questionnaire, Likert 5 points
Liu and Chen [4]	ESL	M-learning vs. e-learning	Perceived Satisfaction	Questionnaire
Lin [5]	EFL	M-learning vs. e-learning	PU, ease-of –use, satisfaction	Technology Acceptance Model (TAM) Questionnaire, Likert 5 points and open ended feedback
Liu and Tsai [30]	EFL	MAR-learning	Satisfaction, fun	Open ended questionnaire
Barreira *et al.* [18]	EFL	AR-learning vs. traditional learning	Satisfaction, ease of use	Questionnaire Likert 5 points
Vate-U-Lan [16]	ESL	AR-learning vs. VR	Satisfaction preference	Preference Questionnaire
Chang *et al.* [17]	EFL	AR-learning	Perceived satisfaction, behavioral intention, effectiveness	Technology Acceptance Model (TAM) Questionnaire, Likert 5 points and open ended feedback
Sanberg, Maris and de Geus [8]	ESL	M-learning vs take home M-learning vs. traditional learning	Motivation, engagement	Qualitative Open and Questionnaire, 4 Likert points for teachers and parents, 2 and 3 multiple choice for students
Hsu and Lee [28]	EFL	M-learning	Perceived satisfaction	Questionnaire, 5 points
Liu, Tan and Chu, [41]	EFL	MAR-learning	Effectiveness: perceived usefulness, user-friendliness and attitudes	Questionnaire, 7 Likert scale, User-friendliness was measure using Technology Acceptance Model (TAM), Cronbach's alpha coefficient.
Liu [18]	EFL	Mobile AR vs. traditional classroom	Effectiveness	Interviews

3.3.1 Technology Acceptance Model (TAM)

Authors like Lin [5], Chang *et al.* [17], and Liu, Tan and Chu [41] are among recent researches in ELT technologies that uses Technology Acceptance Model (TAM) as part of their usability measures. TAM has been a common usability measures used to gauge technology acceptance across vast domains (Figure 13).

Despite first created more than twenty years ago, TAM is still relevant to researchers today. Besides usage in ELT technologies, TAM has still been used by modern researchers such as Baharin et. al. in [43] who evaluates the effectiveness of Interactivity Distance Education Web Learning (IDEWL). Erasmus, Rothmann and van Eeden in [42] on the other hand tested TAM within an enterprise resource planning user environment. Ibrahim in [44] on the other hand expanded and tested the TAM model on the adoption of fantasy sports website.

Other enhancements include researchers like Abroud *et al.* in [45] that has adapted neo TAM model such as the Decomposed Technology Acceptance Model (DTAM) in measuring acceptance in e-finance

industry. TAM is definitely one of the possible model to be considered for expansion in ELT technologies considering the standard model has already been in practice in current works. However the metrics in the model itself has not yet been explored much to suit the technologies in ELT.

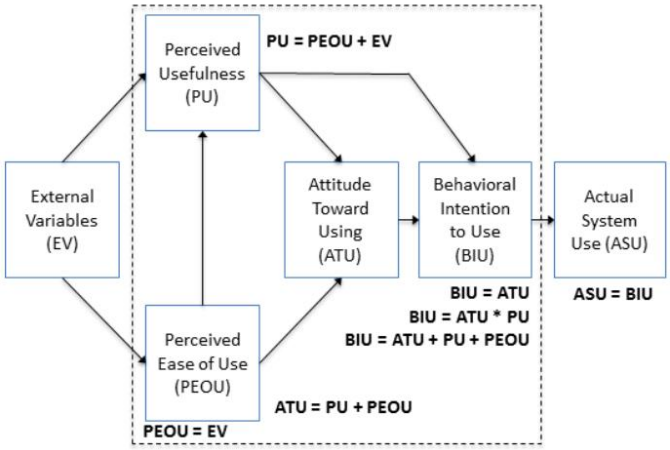


Figure 13 Technology Acceptance Model (Adapted from [42])

3.3.2 Mobile English Learning Satisfaction (MELS)

Mobile English Learning Satisfaction (MELS) model has been developed by Huang [27] to measure the metrics in self-management learning (Figure 14).

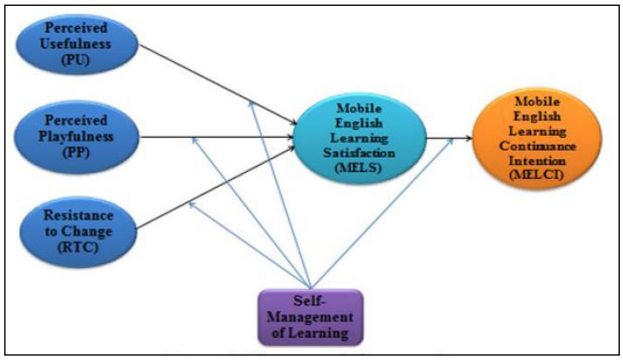


Figure 14 Mobile English Learning Satisfaction (MELS) (Adapted from Huang [27])

Combined with Mobile English Learning Continuance Intention (MELCI), MELS is perceived as a niche usability framework in measuring M-learning in ELT. The possibilities of this model have yet to be explored and there are still limited works found within this domain. MELS is still synonym only with M-learning and little to no work has been found of MELS utilization in the other technologies in ELT.

3.3.3 Handheld Augmented Reality Usability Scale (HARUS)

Handheld Augmented Reality Usability Scale (HARUS) has been designed by Santos *et al.* in [39] to conduct subjective usability measurements on handheld augmented reality applications. Perceived as a niche usability model, HARUS (Figure 15) is claimed to be relevant for handheld augmented reality. The potential of HARUS in measuring ELT technologies is still in infancy and it is believed that more research gaps can be found bridging HARUS with the interactivity of ELT technology interfaces. Similar to MELS, HARUS was introduced recently and has much exploration to be done, especially within the domains of ELT technologies.

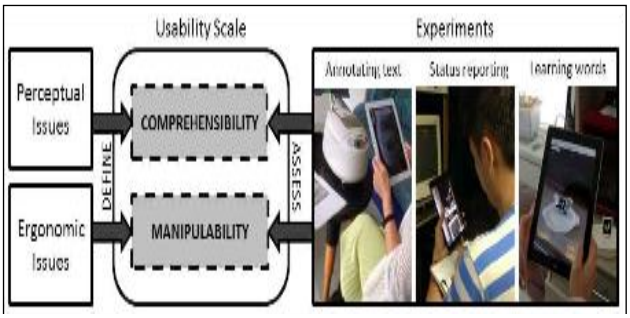


Figure 15 Handheld Augmented Reality Usability Scale (HARUS) (Adapted from [39])

3.4 Usability Techniques - Objective Measures

Objective measures in Usability are quantitative evaluation of performance on Usability metrics. These should produce a reliable and repeatable assignment of numbers to quantitative observations and can be taken automatically or by an experimenter [14]. Objective measures can also be referred to as performance metrics [12]. Even though there are quantitative and objective measures used in the current researches, those measures were focusing on students' performance in English proficiency and content rather than the user interfaces of respective technologies. None of the work in ELT in M-learning or AR-learning or MAR-learning has experimentation conducted using objective measures with techniques such as time-on-tasks and error registration [12]. This perhaps could be a gap in usability measure pertaining technologies involving ELT.

3.5 Usability Techniques - Subjective Measures

In Usability, subjective measures are technically opinion-based data given by participants expressing their experiences. These rely on the subjective judgment of people and include questionnaires, ratings, rankings, or judgments [38]. Subjective measures can also be referred to as self-reported metrics [36]. As mentioned by Olsson in [40], the user experience measurements in general should

essentially be self-reported in order to cover the subjective nature of user experience. All the current works discussed the previous section has adopted subjective measures in evaluating all their metrics. However, despite having standardized subjective measures, there has not been any framework in subjective usability measurement on ELT in MAR-learning. From the works reviewed above, all 12 researchers utilized different methods and techniques of subjective measures. With most of the reviewed works used either individual metrics from different models, or developed niche usability frameworks tailored to their research, many other subjective measures' potential such as System Usability Scale (SUS) in [46], NASA-TLX [39] and Intrinsic Motivation Inventory (IMI) in [47] has yet to be discovered in the area of ELT technologies, more importantly in MAR-learning.

3.6 Current Usability Issues Involving ELT and Current Technologies

From the literature done, 2 research questions emerged as part of the limitations identified in current ELT technologies:

The first question shows that not many usability methods have been used in current works. From literature study shown above, even though usability standards such as ISO 9241-11 1998 exist, many researchers evolve into their own methods rather than creating new framework complying with it. Therefore the question here is how well can ISO 9241-11 standard fit into current usability trends with post WIMP (windows, icons, menu and pointers) technologies

In the second research question, thus far, studies done in usability for M-learning, AR-learning and MAR-learning have been leaning towards qualitative subjective measures despite the risk of clear biases from self-reported results. No research has yet to use usability performance metrics on technology-based ELT. How will performance usability measures co-relate to the performance of using technology-based ELT? Could performance usability show more accuracy in quantitative data compared to qualitative data gathered through self-reported metrics?

4.0 CONCLUSION

The review shown in previous sections strengthens the fact that there are still many unexplored areas of research in ELT and related technologies. The current methodologies so far has highlighted the advantages and disadvantages of digital and self-learning in the context of ELT. Learning through means other than classroom setups has been studied extensively in recent years and teaching methodologies might also meet a significant turning point in ELT traditions. There are also still many unexplored areas of research in ELT and interface usability. Despite emerging methodologies and techniques in usability, many existing usability models and framework has yet to be explored, in terms of suitability towards measuring metrics in current ELT technologies acceptance. This research therefore aspires to continue discovering along this investigative path, uncovering more research gaps and limitations in respective research domains in the near future.

This research will extend the current literature works to include the technical ELT content reviews inclusive of current teaching approaches, pedagogies and interface usability. The review is expected to generate leads to further research in finding gaps between the content technicalities and technological limitations. This research is also expected to analyze the feasibility of producing a framework in the near future to bridge the identified gaps.

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