

## Evaluating the Factors Influencing E-book Technology Acceptance among School Children Using TOPSIS Technique

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### Abstract

Technology can change the nature of learning environment. Moreover, different modes of education enhance the ways in which school children learn. Nowadays, the classroom technology includes interactive learning technology, for example, electronic book (e-book) technology. The e-book is a book that is displayed on a computer screen or on an electronic device that is held in the hand, instead of being printed on paper. Acceptance of a new technology such as e-book technology is important for school children in Malaysia. Despite many claimed benefits, the school children would not accept technology without interaction with a computer. The purpose of this study is to identify determinants of usability and interface factors of Children Computer Interaction (CCI) leading to e-book behaviour intention to use for school children. Through the theoretical background unification of behaviour use intention, in particular, the Technology Acceptance Model (TAM) and interdisciplinary literature review relevant to e-book technology, a comprehensive set of constructs and their interrelationship were found as research hypotheses. The research hypotheses build the development of measurement framework, which was specified in an instrument. To find the importance of factors incorporated in the proposed framework, the data is collected by conducting a survey through a structured questionnaire-based instrument comprising 5-point Likert-type scale and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is applied. The results from this study analyses are discussed and a future research is suggested.

Keywords: Technology Acceptance Model, Interactive learning technology, School children learning, Child Computer Interaction, TOPSIS

### 1. Introduction

There has been an increase in the use of smartphones and tablet devices by adults and children alike in recent years. Unlike older generations, children nowadays grow up using IT devices as part of their daily routine and habit. On one hand, this phenomenon has not gone unnoticed by the IT industry and service providers who view child users as a growing market segment. On the other hand, educators are becoming more concerned about the role of IT devices in the development of children's skills and abilities. It is clear that there is an urgent and present need for more studies about the understanding on the interaction that takes place between children and the technology.

Electronic books (e-books) are but one of the many information technology, which children tend to use it in their learning. E-books are classified as self-contained digital texts, which mimic traditional books but are viewed on an electronic display (Felvégi and Matthew, 2012). The Oxford Advanced Learner's dictionary describes e-book as "a book that is displayed on a computer screen or on an

electronic device that is held in the hand, instead of being printed on paper" (Oxford, 2011). Over the past years, advancement in software and hardware has spawned the development of e-books. E-books have become very popular with the wide deployment of smart tablets and smartphones. Presently, several e-book formats are available in the market, particularly in HTML and Portable Document Format (PDF). The text is easy to download in HTML format and users are able to copy and paste it to other programs. Presently, PDF is the most utilized and common format for e-books in the market. Cavanaugh (2006) explained the reason for the widespread adoption of PDF in e-books is that several major software developers and electronic devices, like Android devices, Sony Readers, Microsoft Windows and Apple, utilize this format.

Despite the increasing popularity of IT-based education and the wide range of targeted subject domains and education levels, Wang and Yang (2014) mentioned that there has not been a consensus about their affordance for elementary learners in published research. For example, Grimshaw *et al.* (2007) found that multimedia features such

as audio narration, sound effects and animations in e-books were helpful in improving the reading comprehension skills of children. In addition to that, Maynard and Cheyne (2005) contended that students who did better on comprehension tests, as compared to those who used printed textbooks, were that ones who used e-books. Furthermore, Korat and Shamir (2008) asserted that children demonstrated improvement in word recognition and phonological awareness when exposed to e-books.

Jong and Bus (2004) posited that children's comprehension of e-book based stories was impeded by the complexity of its electronic features. The behavioural experience of the user interface usually denotes the interactivity. The degree to which users have control over an e-book in a communication process, such as the opportunity to stop, rewind and restart learning or manipulate objects on the screen, was what Williams *et al.* (1988) defined as e-book interactivity. Ray and Satran (1995) mentioned in their research that high-interactivity software encouraged learning by providing users with the necessary controls during self-directed learning. Most studies on the benefits of interactive e-books were done in adult learning environments. However, how children would react to interactive e-books is not well known. As compared to adults, children's cognitive processes do not occur that spontaneously and may react to the interactivity of programmes differently (Wang and Yang, 2014).

Inventing technology for humans has been researched for many years. Initially focusing on ergonomics of use, before turning to more general human issues, this field has now developed to the point where there are different research areas that have niche identities. Human-Computer Interaction (HCI) is that area that concentrates on the relationship between man and machine. The use of interactive products by children is called Child Computer Interaction (CCI) and is a sub-field of HCI. In contrast to HCI, CCI is still finding its footing (Markopoulos *et al.*, 2008). It largely matured from concerns in the use of technology in education and schools.

This research aimed to illuminate the influence of e-book interactivity design on children's learning. This study was conducted among school children who used e-books in their learning. Several Malaysian schools have adopted the use of e-books. We studied school children's use of e-books in their learning to obtain the necessary results. The key inquiry we studied in this research was whether the interactive technology utilized by e-books affected the school children's approach, use and learning outcomes. Very few studies have focused explicitly on the interactivity design of e-books especially in the areas of interface and usability. In addition to this, the effects of external causes on the interface of e-books remained unclear. Hence, in response to the dearth of existing literature, the objective of this study was to examine the factors that influenced the intention to use e-books via the Technology Acceptance Model (TAM) by adding the interface and usability factors of CCI as an external variable.

## 2. The problem statement and contributions

There is a problem for school children's acceptance the e-book technology in their learning process. In recent years, a new stream of research in this field has started gaining attention in regard using Child Computer Interaction (CCI). However, there is a lack of studies, which have researched school children behaviours intention regarding the acceptance of e-book technology in learning. Moreover, a few studies that investigated e-book technology acceptance have neglected significant parts of CCI of e-book technology that is related to usability and interface factors of CCI use. The research addresses the problem of school children accepting the e-book technology in learning.

The problem has negatively affected the school child's learning because the e-book technology is complicated and reports many critical points. One problem pertains to the presence of various digital formats, interface designs, styles and usability. Furthermore, several questions arise from the widespread availability of e-book technology: "Do different categories of school children have different opinions on interactive e-book technology usage?" Another question related is "Do school children prefer to use interactive e-book technology?" A study, which investigates these questions by integrating CCI with TAM, could remedy the situation.

This study proposes a quantitative descriptive research design. It proposes an appropriate an interactive questionnaire instrument especially for the school children as well as to evaluate the factors as proposed in the aforementioned model that influence e-book technology acceptance among school children CCI and TAM of the e-book technology for school children in Malaysia.

The questions that have been raised for this study are: (a) What is the evolution of e-book technology in learning and teaching? (b) What are the technology acceptance theories and models? (c) What is a theoretical framework to evaluate the factors influencing e-book technology acceptance among school children?

The current study explores the importance of Child Computer Interaction (CCI) that plays a significant role in the interest of school children accepting the e-book technology in learning. It shows how CCI contributes to the cognition of school children and technology. The results of this study are expected to contribute and expand to the body of literature theoretically, contextual and methodological in different ways. Moreover, the result from this study can be used to support future research on technology usage by school children at schools. It contributes to the body of knowledge to what extent e-book technology usage assists enhance schools' professional practice, professional evolution and standard of working life.

### 3. Literature Review

#### 3.1 The Evolution of E-book Technology in Learning and Teaching

Technologies are an integral to achieving significant improvements in learning and teaching. They are used to support both teaching and learning for all educational levels. Students and teachers are engaging in using of educational technology at the secondary level (Faizi *et al.*, 2013). Using different tools of educational technology makes teaching and learning more effective and efficient. Nowadays, the technologies are introduced in the classrooms starting from schools to higher education.

E-books and printed books share the content and have one objective in common which is communicating ideas to the reader. However, the two have different approaches in presenting their content and achieving their objectives. The advances in software support and hardware devices made it possible for e-books to achieve their objectives in different forms. Nonetheless, the underlying principles of e-book design fall under four main categories. The first one is the multimedia design and it focuses on the presentation of texts, pictures, animations, and narrations. The second category is interface design and it is concerned with the conventions of use, content presentation, and controls. The third category is learning design and it involves the basic feature of instruction (Roskos *et al.*, 2009). The fourth category is cultural design and it aims at incorporating cultural themes to promote learning (Wang and Yang, 2014).

An optimal design of an e-book should take into consideration all of the above principles (Phadung *et al.*, 2012). The interface design is the most pivotal one for e-books designed for children (Shamir and Korat, 2006). The interface design should consider the displayed content, presentation, view as perceived by the user, in addition to the ability to control all of these factors. The realization of these factors greatly affects product usability, interactivity, and learning quality. E-book Interactivity design refers to the presentation of content and children's control over the e-book (Wang and Wang, 2013). Thus, the learning quality should increase as learners engage in more interactive systems and the positive consequence of the interactive system is referred to as the interactivity effect (Evans and Gibbons, 2007).

By comparing test performance of subjects between those who study with traditional print textbooks and those who study with e-books, the results show that subjects who studied with textbooks tended to perform better on tests than those who studied with e-books (Kim, 2015). This means that students prefer textbooks than e-books. In Malaysia, the new technology e-book technology in schools gives new experience and challenges for the education field. The results of the study by Rahim and Bakar (2014) showed that school children have reasonably core competencies of an e-book using and a good understanding of e-books functions for reading e-books. In sum, the

frequency of e-books usage by school children are quite low (Rahim and Bakar, 2014).

In a study conducted by Noor *et al.* (2012) in Terengganu State Malaysia, e-books were given to primary school pupils. The preliminary feedback of the pupils was that they liked using them in general. The use of e-books in the school helped in reducing the schoolbag weight, on one hand. However, their use as new-age textbooks was not fully utilization, on the other hand. The results reported by Noor *et al.* (2012) show that the use of e-books as was not as often as expected. They reported that teachers rarely used e-books in their teachings in the feedback obtained from 35% of the participants and occasionally used them in the feedback obtained from 65% of the participants.

In addition, Noor *et al.* (2012) suggest that these unexpected results are due to the difficulty of school children following up with classroom lessons whenever e-book start-up time is slow or crash during teaching. Additionally, the results show that 43% of the participants find e-books helpful in understanding the taught lessons. The study concludes that e-books will be used by school children if schools provide the right e-learning environment and adapting teaching methods to utilize e-books as part of school learning by teachers.

According to, to Wang and Wang (2013), an interactive mechanism to use when to read an e-book. That mechanism will help the user to view, read, and further acquire the knowledge. Several studies found that an e-book technology has problems among users. For example, Siegenthaler *et al.* (2010) showed that the current e-book reader generation has large deficits with respect to usability. Users were unable to use e-book readers intuitively and without problems. Additionally, a significant difference between the different brands of e-book readers. They found dissociations between objective eye-tracking data and subjective user data, stressing the importance of multi-method.

In addition, Wang and Yang (2014) posited the general e-book design principles that can be grouped into the following categories: multimedia design (it focuses on how texts, pictures, animations, and narrations are presented), learning design (it includes the fundamental feature of instruction (Roskos *et al.*, 2009) and interface design (it illustrate rule of use, style, design and controls). According to Phadung *et al.* (2012), the above principles should be considered to design an optimal e-book. Shamir and Korat (2006) suggest that the interface design is the most critical factor for children's e-books among the other factors. The design of the interface should consider what interface is presented to the user, and how it is viewed and manipulated by the user.

#### 3.2 The Information Technology Acceptance Theories and Models

Information System (IS) research is influenced by many theories. This study was only concerned with theories related to technology acceptance. The most utilized theories were the Technology Acceptance Model (TAM) (Davis,

1989; Davis et al., 1989), Theory of Planned Behaviour (TPB) (Ajzen and Madden, 1985), Unified Theory of Acceptance And Use of Technology (UTAUT) (Venkatesh et al., 2003) and User Acceptance of Hedonic Information Systems (Heijden, 2004).

Technology acceptance studies are a popular method of predicting future use of IS and related areas. In IS research, TAM and other related user control acceptance models of technology theory and are among the most researched, well-known and widespread theories. Worthy of mention is the remarkable progress achieved over the past few years in forecasting and explaining user acceptance of IT at work. TAM is specifically supported by a considerable amount of theoretical and experimental support (Davis, 1989). Dillon and Morris (1998) defined user acceptance as a demonstrable willingness within a group of users to exploit IT for the tasks it was designed to support. The concept of acceptance is related to situations where designers or procurers will utilize a technology without showing evidence of use. Furthermore, it can also be utilized in situations where technology will be utilized for unplanned situations.

Davis Jr (1986) created a TAM model in 1986 that explained users' acceptance and technology use. Since then, it has gained acceptance as one of the most reputable models for researching technology acceptance. It specifies main reasons for technology acceptance. This makes it useful in elucidating or forecasting the behaviour of individuals across a spectrum of end-user computing technologies and groups. TAM stipulates that numerous factors influence users' decisions regarding when and how they will use technology that is presented to them. These factors are Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) of technology (Davis Jr, 1986). The perceived improvement to the performance of a user's task employing a specific system is defined as the PU whereas the extent to which a user thinks that a specifically utilized system would be effort free is defined as the PEOU. TAM has been utilized in conditions where users use new technology. It has proven to be useful when applied to different technologies (Davis, 1989), such as an academic (Bong and Skaalvik, 2003; Orji, 2010; Vallerand et al., 1992), Personal Computer (PC) (Moran et al., 2010; Moran, 2006), Tablet PC (Elyazgi et al., 2014; Park and Pobil, 2013).

Davis Jr (1986) reasoned that TRA was a suitable model for explaining and forecasting the behaviour of users since the actual use of a system was related to the behaviour itself. Davis made two main changes to the TRA model. The first was in the actual behaviour for individuals and the second was the adoption of PEOU and PU measures in predicting the attitude of the user towards system utilization. According to Pai and Huang (2011), TAM used TRA as the theoretical basis to explain the relationship between PU, PEOU, users' attitudes, intentions and actual usage behaviour. The external variables usually included system attributes, individual training, individual involvement design and the nature of the execution process (Venkatesh and Davis, 1996). TAM hypothesised that PU

and PEOU facilitated the influence of external variables, for example, technology characteristics, the development process and training on an intention to use. PU also swayed PEOU, if other variables were comparable, and the technology could be more useful if it was easy to learn (Venkatesh and Davis, 2000).

There were still several unexplored studies pertaining to potential applications that could contribute to TAM's predictive validity despite a continuous progress in the detection of new factors with significant effects on its primary variables (Marangunić and Granić, 2014). School children's perspective of the acceptance of e-learning as a tool for integrating school education was explored by Deshpande et al. (2012) in India. TAM was used to model the factors that influenced, for instance, PEOU, PU, attitudes and intentions to adopt e-learning for school children. The findings indicated that TAM was a partially useful tool to forecast children's Behavioural Intention (BI) towards the adoption of e-learning (Deshpande et al., 2012). Extended TAM assisted the schools' management and teachers to garner more information and experience in using new technology like e-books. Additionally, TAM would assist in preparing them to confront any changes in the teaching and learning process (Deshpande et al., 2012).

School children are increasingly expected to accept technology for learning and information technology. The technology has a widespread information infrastructure in many Malaysian schools and Technological devices accepted by school children. The devices include the Tablet PCs, interactive whiteboards and e-book for educational purposes, as reported in prior studies (Dündar and Akçayır, 2014; Elyazgi et al., 2014; Embong et al., 2012; Engen et al., 2014; Hall et al., 2012; Ip et al., 2008; Miller and Warschauer, 2013; Rahim and Bakar, 2014; Elyazgi et al., 2015). Some research reported that some Malaysian school children did not agree to the use of new technologies due to the lack of adequate support to the TPC initiative by the school authorities. Elyazgi et al. (2014) indicated that only 46% of Malaysian 8th-grade students expected to use tablet PCs (TPC) in the future. Technical issues inherent in TPC technology and the lack of digital pens, like in other commercially available tablets, were some of the contributing reasons to the low acceptance rate of TPC usage by Malaysian school children. In summary, the majority of research was done with non-students while a minority was with higher education students (Yousafzai et al., 2007).

#### 4. Related Work

Researchers to examine the effects on BI to accept and use the system used external factors in TAM, like the interface style of the menu and command-based interface. The influence of menu and command interfaces, which were based on BI of the user to use the system were examined Hasan and Ahmed (2007). Their results indicated that the interface style had a significant positive correlation on BI to use the system (Hasan and Ahmed, 2007). Furthermore, e-learning was part of the Internet



technologies that was utilized to distribute a wide range of solutions to improve instructional processes. To support various elements such as audio and video, text, graphics and messages, e-learning environments should integrate both synchronous and asynchronous communications. For example, Malaysian students' grades in e-learning were highly correlated with student's interactivity (Poon et al. (2004).

A few studies have shown the relationship between interaction and positive outcomes. External variables such as system interactivity have been proven by research to have a positive influence on technology acceptance (Abbad, 2011). Interaction is defined as the communication behaviour between two or more objects that affected each other (Lee, 2009). The most popular interface styles that influenced interactions were command line interfaces, menus-based interfaces, fonts, texts, point-and-click and three-dimensional interfaces (Dix et al., 2003). The text and graphic layouts presented on a computer screen were defined by Cheon and Grant (2012) as the user interface. Interface design and the functionality of the e-learning technology positively influenced PEOU (Fu et al., 2007). Joo et al. (2014) reported that from the result, the three types of user interface all had significant effects on PEOU and PU. Moreover, the authors Joo et al. (2014) concluded and highlighted user interface as an important factor that affects PU and PEOU by learners.

The intention to use digital libraries were significantly affected by ease of use, which in turn was influenced by user interface elements like terminology, navigation, and screen design (Joo et al., 2014). Moreover, user interface style has a significant influence on PU and PEOU (Hasan and Ahmed, 2007). Similarly, TAM was further developed by Cho et al. (2009) with the addition of user interface, functionality, system resources and user satisfaction. Poon et al. (2004) surmised that system interactivity was a predictable factor that might influence students' adoption of technology.

Human-Computer Interaction (HCI) specialists opinionated that products should be developed in such a way that satisfied user's needs and expectations in order to support effective technology use. However, there were very limited studies on the design issues of technology products for children. Usability of a product was closely tied to children's enjoyment of it (Hanna et al. (1999). Abbad (2011) proposed a conceptual research framework of e-learning adoption based on the TAM model. It posited that there was a significant relationship between interactivity systems and learning effectiveness. Ramayah (2006) found that the screen design, terminology clarity and navigation clarity were positively related PEOU during a research on an online library.

Children's literacy and language development were found by Chau (2008) to be related to their enjoyment of e-books. Due of the added functionality and the available interactivity of e-books, Miller and Warschauer (2013) reported that children showed more cooperation with their peers and retained more information.

When a task is enjoyable and offers external rewards, users will make an effort. Hence, users will be accepted of technology due to the fun and perceived benefits. Pleasure and enjoyment are the stimuli for accepting or rejecting a new technology (Igbaria et al., 1995). Igbaria et al. (1995) indicated that the PEOU, indirectly through its influence on PU and PE, played a major part in influencing the use of computer technology. Perceived Enjoyment (PE) is added as a determinant of PEOU in TAM 3 (Venkatesh and Bala, 2008).

Due to that fact that the integration of PE stresses on the emotional side of e-book usage, it becomes valuable in explaining the of technology acceptance of hedonic systems. The empirical research by Heijden (2004) backs the hypotheses that the PE was found to be positively correlated to intention to use a hedonic information system. It can be implied that PEOU may have positive effects on PE in the light of these relationships,

Davis et al. (1989) found that PEOU was a major construct of PU. According to the researchers, a system was perceived to be more useful if it was easier to use. A user can easily complete the system's task if the system was easy to use (Venkatesh and Davis, 2000). Letchumanan and Muniandy (2013) researched the significant contributions of PEOU to PU. In the adoption of technological products and e-books, scholars found that PEOU was a strong determinant of PU (Chang et al., 2012; Davis, 1989; Lee, 2013; Letchumanan and Muniandy, 2013). There was a noteworthy association between PEOU and PU (Nasri and Charfeddine, 2012). Park and Chen (2007) indicated that the PEOU of smartphones positively affected PU. In consideration of these relationships, it could be suggested that PEOU may have positive effects on PU. Moreover, PEOU is positively correlated to PU in the use e-book technology (Letchumanan and Tarmizi, 2011).

From past research, TAM hypothesized that PEOU and PU governed a user's BI to use or utilize any information technology. For examples, Abbad (2011) posited that PU and PEOU would mediate the relationship between external variables and BI to use a system as well as they have an influence upon technology acceptance. Furthermore, PU was hypothesized as a direct determinant (a core construct) of BI such as in TAM (Davis, 1989), TAM2 (Venkatesh and Davis, 2000) and Augmented TAM or C-TAM-TPB (Taylor and Todd, 1995). PU was also hypothesized in several applications, for example, BI was significantly influenced by PU in the use of YouTube for procedural learning (Lee and Lehto, 2013), PU had a positive effect on BI in the use of online banking (Yaghoubi, 2010) and PU had a significant effect on BI in e-learning technology (Masrom, 2007). The adoption of smartphone technology was reported by Park and Chen (2007) to be positively related to PEOU as well as having a positive impact on PU. The intentions to use the online library was also found to be positively related to PEOU (Ramayah, 2006). In his study on user acceptance of hedonic information system, Heijden (2004) indicated that PE and PEOU were stronger determinants of intentions to use hedonic information systems than PU.

Aside from any performance consequences resulting from system use, PE is the extent to which the activity of using a specific system is perceived to be enjoyable in its right (Davis et al., 1992). Usually, young people were noticed to have higher enjoyment in relation to technology adoption. Prior research also indicated that PE had a major influence on BI to use hedonic systems (Davis et al., 1992; Hsu and Lu, 2004; Van der Heijden, 2004). They proposed an extended version of the original TAM (Davis, 1989) that was inspired by computer game research that integrated PE as a direct impact factor on intention to use. In the determination of intention to use technology, Davis et al. (1992) indicated that PU was four to five times as important as PE. It can be suggested that PE may have positive effects on BI with reference to these results. In addition, PE had a positive impact on the behaviour and intention to use e-book technology (Antón et al., 2013; Siegenthaler et al., 2010).

## 5. The theoretical research framework

A theoretical framework is set of theories and models that were mentioned in literature reviews (Hussey, 1997). In other words, it provides a theoretical model of how related theories provide the relationships among the identified factors that are important to the problem. It is also important to understand the types of variables and their associated meanings.

This study researched the different types of factors influencing e-book technology usage in schools. According to Van der Heijden (2004), past research adopted TAM as their research framework. Significant factors like PU, PEOU, PE and BI, in TAM were found by him to be significant in explaining the use of the e-books for school children. By extending TAM with CCI, a more comprehensive theoretical model was constructed for this study. The suggested research model (the theoretical framework) in Fig. 1 was developed based on significant types of variables such as CCI and revised TAM by Van der Heijden (2004). CCI (independent variable), PE (mediator variable), PU (mediator variable) and PEOU (mediator variable) determined BI (dependent variable) in this proposed model. This research studied various factors influencing e-book technology application in schools. Previous studies adopted TAM as their research framework according to Van der Heijden (2004).

Four essential factors including CCI, PU, PEOU and PE, were shown to directly influence the intensity of the user's behavioural intention to use e-book technology, which was initially proposed by the research framework that identified the interrelationships among the constructs. The following sections will indicate past studies related to TAM as well as CCI studies, which studied the relationships among the constructs.

### 5.1 Usability

The extent to which specific users were able to achieve specified goals with effectiveness, efficiency and

satisfaction in a specified context of product use was defined as the usability (Standardization, 1998). The usability of the product was measured thru three main quality criterions with the use of this standard. Firstly, effectiveness that was the measurement of how well the user was able to use the product to accomplish the aim. Secondly, efficiency, which was related to how fast a user could complete a task. Finally, satisfaction, which was a subjective measurement of how pleasant it was to use the system (Sharp et al., 2007; Standardization, 1998). Therefore, if users realized that a system was not easy to use (very difficult to use), that perception may impact their ability to utilize materials provided by the system (Anjaneyulu et al., 1998). Moreover, from the user's point of view, usability was usually connected to the development of interactive products in areas of product affectivity, learning the product easily and enjoyment (Sharp et al., 2007).

Usability was classified as a major concern in interface design. Nielsen (1994) mentioned that usability had five attributes: i) learnability: how users learn easily and use rapidly; ii) efficiency: productivity level after user has learnt to use the system; iii) memorability: user is able to use system after a period inactivity and without having to relearn everything; iv) errors: the number of errors when using the system; v) satisfaction: whether user was satisfied during use of system (Nielsen, 1994).

### 5.2 Interface

The main interface of the interaction between the system and user is the dialog menu. The dialog environment is significantly affected by the choice of interface style. The most common interface styles that affect interactions included WIMP (windows, icons, menus and pointers) menus-based interface, question/answer and query dialog, point and click, command line interface and three-dimensional interfaces (Dix et al., 2003). WIMP is currently the main interface style in use for a majority of interactive computer systems, especially in PCs and desktop workstations. Most WIMP systems have nearly same elements: windows, icons, menus, pointers, dialog boxes and buttons (Dix et al., 2003). However, the accurate behaviour of these elements varies from a single environment and between environments. Through the interface of an affordable device, Wang and Huang (2015) mentioned that users can enjoy fun, aesthetic and pleasurable interactive products. The key factors for communication between users and products are the interface languages applied to the user interface of mobile e-books. Moreover, Wang and Huang (2015) surmised that the main points affecting users' interface operation were aesthetics, achievement and friendliness.

### 5.3 Child Computer Interaction

Child Computer Interaction (CCI) is a growing discipline, which studies the children use of interactive systems. CCI is a branch of HCI (Markopoulos et al.,

2008). The application of CCI principles can be found in technology-based systems related to education, sociology, art design, and storytelling. As technology influences the way people actual work, people use of technology also has an influence on technology. The impact of technology on children has been addressed previously in several studies

(Elyazgi et al., 2014; Kucirkova et al., 2014; Ronimus et al., 2014; Roskos et al., 2014). It is becoming more crucial to study the influence of children use of technology. User interface refers to a system artefact that is designed to allow for interaction between the system and the user (Phillips, 2012).

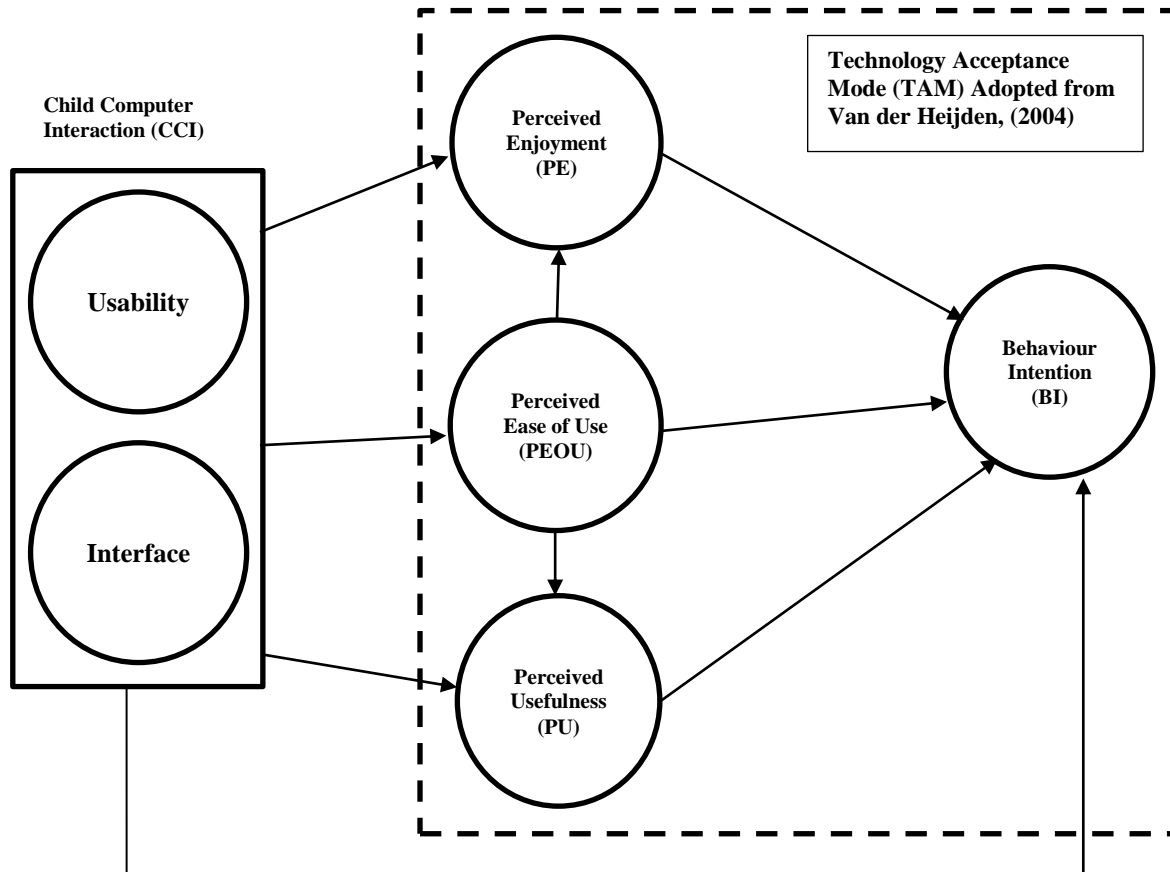


Fig. 1. The Proposed Research Model

#### 5.4 Perceived Enjoyment

A third belief is considered by Davis et al. (1992) as an important complement to TAM, which is called Perceived Enjoyment (PE). This idea is defined as the degree to which computer using activity is perceived to be pleasing in its right, without considering the performance consequences that might be estimated (Davis et al., 1992). PE definition indicated the degree to which fun can be acquired from using the system as such. PE focuses on intrinsic motivation. In the acceptance of learning system context of the user, Lee et al. (2005) posited that the intrinsic motivation is derived from emotional feeling like pleasure, frustration or unhappiness. Thus for utilitarian systems, we can anticipate that extrinsic motivation are the central predictor of intentions to exploit the system at the cost of intrinsic motivation (Van der Heijden, 2004). As an effect of enjoyment on technology acceptance has lack studied in the perspective of technologies related to education for school children, this relationship accounts for an important benefit of this study.

When comparing the PE for learning the environment and e-book technology environment, a conclusion for developing technology acceptance model is that the PE has a role in technology acceptance and has an impact on the future intention of use. Davis et al. (1992) considered PE a significant additional to TAM as third belief. A few studies have been shown the relationship between PEOU and PE in TAM context applied for entertainment technologies (Van der Heijden, 2004). Heijden (2004) uses a revised version of TAM, which includes only the factors PEOU, PU and PE as direct impact factors on intention to use.

#### 5.5 Perceived Usefulness and Perceived Ease of Use

The Perceived Usefulness (PU) is defined as the extent to which a user thinks that the performance of his or her task performance will be improved by employing a specific system. PU is the most important factors of the computer intention. PU in TAM (Davis, 1989), TAM2 (Venkatesh and Davis, 2000) and Augmented TAM or Combined TAM and TPB called (C-TAM-TPB) (Taylor and Todd, 1995) was posited as a direct construct of BI.

While the Perceived Ease of Use (PEOU) is defined as the extent to which a user thinks, which employing a

specific system would be effort free. PEOU is the second decisive factors of the computer intention. PEOU was also theorized as the direct determinant of BI in a number of theories and models including TAM, TAM2, TAM3 and C-TAM-TPB.

TAM has been applied to situations where a new technology is presented to users. It was shown to be useful when applied to different technologies (Davis, 1989). PEOU and PU dimensions have been regarded as significant in identifying the individuals' use and adoption of IT (Keil et al., 1995; Malhotra and Galletta, 1999). Lee et al. (2003) traces TAM's history, investigates its results, and carefully predicts its future track, the relationship between PU and BI is strongly significant. The previous studies posited that PU is a stronger determinant of BI. TAM theorized that PU and PEOU mediate the influence of external variables, for examples, technology characteristics, the development process and training on an intention to use. PU is also influenced PEOU as if other things are equivalent, the technology can be more beneficial if it is easy to learn it (Venkatesh and Davis, 2000).

### 5.6 Behaviour Intention

The Behavioural Intention (BI) construct is an indicator to the actual usage prediction that has been successful thus far (Ramayah and Ignatius, 2005). BI is defined by Warshaw and Davis (1985) as "the degree to which a person has formulated conscious plans to perform or not perform some specified future behaviour". In addition, it is consistent with the TRA (Fishbein and Ajzen, 1975) and TPB (Ajzen, 1991) that assert that BI is a robust predictor of actual behaviour. Several scholars have been used successfully TAM to predict the BI towards the use of IT (Deshpande et al., 2012; Fridin and Belokopytov, 2014; Gerlach and Buxmann, 2013; Hiramatsu and Nose, 2013; Ramayah and Ignatius, 2005; Shroff et al., 2011).

## 6. Methodology

### 6.1 TOPSIS Method

Multi-Criteria Decision Making (MCDM) is the most well-known decision making, and it is a branch of Operations Research (OR), which deal with decision problems under a number of decision criteria (Nilashi and Ibrahim, 2014; Nilashi and Janahmadi, 2012; Nilashi et al., 2012; Nilashi et al., 2011a; Nilashi et al., 2011b; Nilashi et al., 2011c; Nilashi et al., 2011d; Nilashi et al., 2011e; Nilashi et al., 2015a; Nilashi et al., 2014a; Nilashi et al., 2015b; Ahmadi et al., 2014; Ahmadi et al., 2013; Ahmadi et al., 2015a; Ahmadi et al., 2015b)

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), one of the known classical Multiple Criteria Decision Making (MCDM) methods, was first developed by developed by Yoon (1980) can be used with both normal numbers and fuzzy numbers. TOPSIS is has been widely used in dealing with MCDM problems. It makes full use of attribute information, provides a cardinal

ranking of alternatives, and does not require attribute preferences to be independent. To apply this technique, attribute values must be numeric, monotonically increasing or decreasing, and have commensurable units. The procedure of the TOPSIS method consists of the following steps Hwang and Yoon (1981):

Given a set of alternatives,  $A = \{A_i | i = 1, \dots, n\}$ , and a set of criteria,  $C = \{C_j | j = 1, \dots, m\}$ , where  $\tilde{X} = \{\tilde{x}_{ij} | i = 1, \dots, n; j = 1, \dots, m\}$  denotes the set of ratings and  $\tilde{W} = \{\tilde{w}_j | j = 1, \dots, m\}$  is the set of weights. The first step of TOPSIS is to calculate normalized ratings by

$$\tilde{r}_{ij}(\mathbf{x}) = \frac{\tilde{x}_{ij}}{\sqrt{\sum_{i=1}^n \tilde{x}_{ij}^2}}, \quad i = 1, \dots, n; \quad j = 1, \dots, m \tag{1}$$

and then to calculate the weighted normalized ratings by

$$\tilde{v}_{ij}(\mathbf{x}) = \tilde{w}_j \tilde{r}_{ij}(\mathbf{x}), \quad i = 1, \dots, n; \quad j = 1, \dots, m. \tag{2}$$

Next the positive ideal point (PIS) and the negative ideal point (NIS) are derived as

$$\begin{aligned} PIS &= \tilde{A}^+ = \{\tilde{v}_1^+(\mathbf{x}), \tilde{v}_2^+(\mathbf{x}), \dots, \tilde{v}_j^+(\mathbf{x}), \dots, \tilde{v}_m^+(\mathbf{x})\} \\ &= \{(max_i \tilde{v}_{ij}(\mathbf{x}) | j \in J_1), (min_i \tilde{v}_{ij}(\mathbf{x}) | j \in J_2) | i = 1, \dots, n\} \\ NIS &= \tilde{A}^- = \{\tilde{v}_1^-(\mathbf{x}), \tilde{v}_2^-(\mathbf{x}), \dots, \tilde{v}_j^-(\mathbf{x}), \dots, \tilde{v}_m^-(\mathbf{x})\} \\ &= \{(min_i \tilde{v}_{ij}(\mathbf{x}) | j \in J_1), (max_i \tilde{v}_{ij}(\mathbf{x}) | j \in J_2) | i = 1, \dots, n\} \end{aligned} \tag{3}$$

where  $J_1$  and  $J_2$  are the benefit and the cost attributes, respectively. Similar to the crisp situation, the following step is to calculate the separation from the PIS and the NIS between the alternatives. The separation values can also be measured using the Euclidean distance given as:

$$\tilde{S}_i^+ = \sqrt{\sum_{j=1}^m [\tilde{v}_{ij}(\mathbf{x}) - \tilde{v}_j^+(\mathbf{x})]^2}, \quad i = 1, \dots, n \tag{4}$$

$$\tilde{S}_i^- = \sqrt{\sum_{j=1}^m [\tilde{v}_{ij}(\mathbf{x}) - \tilde{v}_j^-(\mathbf{x})]^2}, \quad i = 1, \dots, n \tag{5}$$

$$\max\{\tilde{v}_{ij}(\mathbf{x})\} - \tilde{v}_j^+(\mathbf{x}) = \min\{\tilde{v}_{ij}(\mathbf{x})\} - \tilde{v}_j^-(\mathbf{x}) = 0. \tag{6}$$

Next, the similarities to the PIS is given as

$$C_i^* = \frac{D(S_i^-)}{[D(S_i^+) + D(S_i^-)]}, \quad i = 1, \dots, n \tag{7}$$

where



$$C_i^* \in [0,1] \quad \forall i = 1, \dots, n \quad (8)$$

Finally, the preferred orders are ranked according to  $C_i^*$  in descending order to choose the best alternatives.

### 6.2 Ascertaining the entropy weight vector

Information entropy is an uncertainty measure in information theory. Using the entropy method, objective weights are calculated.

Objective weights of the objective ratios can be determined by Shannon's entropy concept Shannon and Weaver (1947). In this research, the concept of entropy is applied to determine the criteria weight. According to Ding and Shi (2005) and Zeleny (1982), entropy is a term in information theory, also known as the average amount of information. The criteria weights are calculated by the entropy method. According to the degree of index dispersion, the weight of all indicators is calculated by information entropy. Entropy method is highly reliable and can be easily adopted in information measurement Zou et al. (2005).

Formally, the entropy method begins with a normalization process using the values of matrix  $N = (n_{ij})_{n \times m}$  ( $n$  alternatives and  $m$  indicators) by the following specific formulation Hwang and Yoon (1981):

$$n_{ij} = r_{ij} / \sum_{i=1}^n r_{ij} \quad (9)$$

The following equation calculates entropy measure of every index:

$$E_j = -K \sum_{i=1}^n [n_{ij} \ln(n_{ij})] \quad \forall j = 1, 2, \dots, m \quad (10)$$

$$K = \frac{1}{\ln(n)}$$

The degree of divergence  $d_j$  of the intrinsic information for each criterion  $C$  ( $j = 1, 2, \dots, n$ ) may be calculated as:

$$d_j = 1 - E_j \quad (11)$$

The value  $d_j$  represents the inherent contrast intensity of  $c_j$ . The higher the  $d_j$ , the more important the criterion  $c_j$  is for the problem. The objective weight for each criterion can be obtained. Accordingly, the normalized weights of indexes can be calculated as:

$$W_j = \frac{d_j}{\sum_{k=1}^m d_k} \quad (12)$$

Since  $E_j$  is less than or equal to one, the entropy weights are therefore always positive.

### 6.3 Data Collection

The deliverable of quantitative research depends on collecting data to fit a factual basis for data analysis. Data collection commonly refers to the development of the data collection plan with clear and unclear elements. The target population of this study is cleared that applies to school children who are using e-book technology in their learning at schools located in Malaysia during the 2014–2015 school year. The total number of school children was 417. Contact was made with the schools' principals. Letters of introduction and questionnaires were distributed among these schools.

The responses of school children of substances will be used in forming the measures. The items can be formulated as assessment questions. Items were carefully selected so that to cover all parameters included in the theoretical framework. The items in the questionnaire were presented in groups relating to each parameter. The survey instrument extends the TAM to include a CCI. There are three parts in the questionnaire. The first part of the survey instrument used in this study contains four closed-ended demographic questions. The questions ask school children to provide information about their gender, age, school name and level of education (grade). The second part contains questions PEOU, PU, PE and BI. Moreover, there are questions related to CCI. Items to measure PU, PEOU and BI were generated based on the procedures suggested by Venkatesh, et al. (2003) while the items to measure PE were generated based on the procedure suggested by Davis, et al. (1992). The third part of the questionnaire contains questions on CCI. It contains two sections: Usability and Interface. Items to measure the usability were generated based on the Chin et al. (1988) while the items to measure the interface were generated based on Lewis (1995). The items were then modified for the context of e-book technology.

Revilla et al. (2014) recommended that if researchers want to use agree–disagree, they should offer five answer categories rather than seven or eleven because the latter resulting data of lower quality. Therefore, this study uses 5-point Likert scales answers for school children (1) “Strongly Disagree”, (2) “Disagree”, (3) “Neutral Agree”, (4) “Agree”, and (5) “Strongly Agree” for the second part and the third part. Several items will be used as instruments throughout the data collection of this study.

### 6.4 Data Analysis

After data collection, we applied TOPSIS technique to rank the factors and sub-factors in each group, which influence the students' intention to use. Using the entropy method, objective weights were calculated and finally the ranks of all factors were calculated. Accordingly, the Positive Ideal and Negative Ideal (using Equation 3) are presented in Table 1. The calculated entropy measures of every index using Equations (10)–(12) are presented in matrix  $W$ . From the Table 1 and  $W$ , the final ranks (using Equation 7) of sub-factors and factors are presented in Table 2 and Table 3, respectively.

**Table 1**  
Positive Ideal and Negative Ideal

<b>Max V<sub>i1</sub></b>	<b>Max V<sub>i2</sub></b>	<b>Max V<sub>i3</sub></b>	<b>Max V<sub>i4</sub></b>	<b>Max V<sub>i5</sub></b>
0.2456	0.423	2.234	6.234	7.551
<b>Min V<sub>i1</sub></b>	<b>Min V<sub>i2</sub></b>	<b>Min V<sub>i3</sub></b>	<b>Min V<sub>i4</sub></b>	<b>Min V<sub>i5</sub></b>
0.0321	0.145	0.176	1.343	2.199

$$w_1 = 0.05, w_2 = 0.09, w_3 = 0.17, w_4 = 0.31 \text{ and } w_5 = 0.38 \Rightarrow W = \begin{bmatrix} 0.05 & 0 & 0 & 0 & 0 \\ 0 & 0.09 & 0 & 0 & 0 \\ 0 & 0 & 0.17 & 0 & 0 \\ 0 & 0 & 0 & 0.31 & 0 \\ 0 & 0 & 0 & 0 & 0.38 \end{bmatrix}$$

**Table 2**  
The final ranks of all sub-factors.

Factors	$\frac{D(S_i^-)}{[D(S_i^+) + D(S_i^-)]}$	Weight
1. Enables me to achieve the learning more quickly		0.477
2. Improves my learning performance		0.416
3. Increases my learning productivity		0.428
4. Enhances my effectiveness on the learning		0.417
5. I would find the e-book technology useful in my learning		0.418
1. Learning to operate the e-book is easy for me		0.504
2. It provides an attractive learning environment		0.455
3. My interaction with e-book is clear and understandable		0.457
4. It is easy for me to become skillful at using the e-book		0.485
5. It is easy to use		0.533
1. I find using it to be enjoyable		0.429
2. The actual process of using the e-book is pleasant		0.396
3. I have fun using the e-book		0.417
1. I intend to increase my use e-book in the future		0.356
2. I expect to increase my use e-book technology in the future		0.374
3. I plan to increase my use e-book technology in the future		0.367
1. E-book technology has all the functions and capabilities I expect it to have		0.367
2. The contents in the e-book technology is effective in helping me complete the tasks		0.418
3. I am able to complete my work efficiently using the e-book		0.374
4. The information provided with the e-book is clear		0.431
5. The system gives error messages that clearly tell me how to fix problems		0.283
6. I am able to complete my work quickly using the e-book technology		0.349
7. The interface of e-book technology is pleasant Comment		0.370
8. I can effectively complete my work using the e-book technology		0.400
9. The information provided for the e-book technology is easy to understand		0.432
1. Reading characters on the screen is ease		0.477
2. Organization of information is clear		0.486
3. Sequence of screens is clear		0.450
4. Position of messages on screen is consistent		0.415
5. Error messages is helpful for me		0.311
6. Help messages on the screen is helpful		0.329
7. The screen layout and design is appropriate		0.465
8. The configuration colour and background is clear and harmonious for the e-book technology		0.433
9. Remembering names of menus and use of commands		0.295

**Table 3**

The final ranks of all main factors.

Main Factor	Weight
Perceived Usefulness	0.4314
Perceived Ease of Use	0.4866
Perceived Enjoyment	0.4142
Behaviour Intention	0.3657
Usability	0.3802
Interface	0.4068

## 7. Discussion and Conclusion

The current study has investigated the evaluation of the factors as proposed in the aforementioned model that influence e-book technology acceptance among school children. In overall, the findings from this study show that there are significant differences in all factors that influence the e-book technology acceptance among school children. In addition, the current findings show that the school children acceptance of e-book technology were affected by the child computer interaction such as usability and interface through the perceived ease of use, perceived usefulness and perceived enjoyment where these factors were rarely studied for school children. The results are in agreement with previous studies by (Fischer, 2001; Heijden, 2004; John and Kieras, 1996; Lam et al., 2009; Pedersen and Nysveen, 2003; Ramayah, 2006; Shneiderman and Hochheiser, 2001) focused on interface and usability, and confirm that perceived usefulness, ease of use and perceived enjoyment enhance behavioural intentions to use the technology.

Table 2 and Table 3 list the items weight of the factors and the final ranks of all main factors, respectively. First, the usefulness of e-book technology is recorded high in item 1 that school children can achieve their learning more quickly while it is recorded lowest in item 2, which shows that the improvement their learning performance. Second, the perceived ease of use of the e-book technology is recorded high in item 5 where the school children feel e-book technology is easy to use while it is recorded lowest in item 2 that e-book provides an attractive learning environment. Third, the perceived enjoyment of the e-book technology is recorded high in item 1 that the e-book technology is enjoyable for school children while it is recorded lowest in item 2 which the actual process of using the e-book is pleasant. Fourth, the school children behaviour intention test reveals that the e-book technology is recorded high in item 2, which expect to increase the use e-book technology in the future while it is recorded lowest in item 1, which means that the school children intend to increase their use e-book in the future. Fifth, the usability of e-book technology is shown high in item 9 that the information provided for the e-book technology is easy to understand while it is recorded lowest in item 5 where the system gives error messages that clearly tell them how to fix problems. Finally, the interface of the e-book

technology is noted in item 2 that organization of information is clear while it is recorded lowest in item 9 that remembering names of menus and use of commands.

The data analysis indicates positive results about perceived usefulness, perceived ease of use, perceived enjoyment, school children behaviour, usability and interface. Using the child computer interaction (i.e. usability and interface) with TAM factors as a model. The result shows positively that the school children accept the usage of an e-book by school children in school. From table 3, the highest rank scale of factors is perceived ease of use while the lowest rank of factors is behaviour intention. This is because of several of the features and functions are available in the e-book technology to seem to be easy to learn and use. However, there are concerns with the various other aspects of the technology such as the usability and interface. Usability scale, which is lower than interface scale of the e-book technology, shows that school children acceptance of the e-book technology will increase if it is perceived as supporting a high level of interactivity.

The findings of this study may be useful for educational technology strategy such as which factors of e-book technology to emphasize for evaluation, and offer a different perspective for scholars understanding of school children acceptance of e-book technology. In addition, the usability and interface beside of perceived usefulness, perceived ease of use, perceived enjoyment and behaviour intention are important for e-book technology acceptance among school children. Therefore, the e-book technology acceptance is able to use factors (perceived usefulness, perceived ease of use, perceived enjoyment, interface, usability and behaviour intention) in the proposed model as their evaluation indexes, to examine the e-book technology usage in schools, which were shown positively in the results. "The establishment of e-book technology for school children in learning materials and teaching strategies theme design, planning and deployment, may enhance the effectiveness of student learning high action interactive learning environment - the future classroom, as the future development of mobile learning systems or collaborative learning system reference." (Wen et al., 2011).

In sum, an integration of TAM with CCI comprises a holistic view. It indicates that acceptance of new technologies involves school children as well as technology specific factors. In our view, a fundamental aspect of research is that it should be applicable. In this respect, an

integration of TAM and CCI is future-oriented, innovative, and useful. It is our hope that this study helps to provide more answers and a foundation for future investigations.

As the present study focuses on the case of a new technology at schools, e-book technology, still in the early stages at only international schools in Malaysia while very few governmental schools use e-book technology. In the meanwhile, although these findings contribute to the body of knowledge and literature, some limitations require further examination and demand additional research such as finding the relationship among these factors by using hypotheses.

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