Students’ Acceptance Towards Kit-Build Concept Map Authoring Tool in Supporting Learning of English Reading Comprehension

Aryo Pinandito†
aryo@ub.ac.id
Department of Information System, Faculty of Computer Science, Universitas Brawijaya Malang, Jawa Timur, Indonesia

Chandrawati Putri Wulandari∗
Department of Industrial Engineering, Faculty of Advanced and Multidisciplinary Technology, Universitas Airlangga Surabaya, Jawa Timur, Indonesia chandrawati.p.w@stmm.unair.ac.id

Didik Dwi Prasetya
Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Malang Malang, Jawa Timur, Indonesia didikdwi@um.ac.id

Tsukasa Hirashima
Department of Information Engineering, Graduate School of Engineering, Hiroshima University Higashihiroshima, Japan tsukasa@lel.hiroshima-u.ac.jp

Yusuke Hayashi
Department of Information Engineering, Graduate School of Engineering, Hiroshima University Higashihiroshima, Japan hayashi@lel.hiroshima-u.ac.jp

Hanifah Muslimah Az-Zahra
Department of Information System, Faculty of Computer Science, Universitas Brawijaya Malang, Jawa Timur, Indonesia hanifah.azzahra@ub.ac.id

Didik Dwi Prasetya
Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Malang Malang, Jawa Timur, Indonesia didikdwi@um.ac.id

ABSTRACT
In facing the new pandemic situation, students and educators had to switch their learning activities into online learning and quickly adapt the educational technologies to support distance learning. Sophisticating innovations in educational technologies are highly required to overcome change. Delivering digital content and activities in a distance learning environment has potential advantages in improving the students’ engagement in learning. Concept mapping is known to support students’ learning process and help them learn better. A concept mapping authoring tool built to support learning with the Kit-Build concept map framework has been developed to incorporate computer technologies into digital concept mapping activities. This research investigates to what extent the students’ technology adoption towards the Kit-Build concept map authoring tool as a digital concept mapping tool supports the students to learn English reading comprehension. This research incorporates the Technology Acceptance Model to evaluate students’ acceptance towards the tool and uses three external variables, i.e., compatibility, habit, and enjoyment for the TAM model. Most of the result presented in this research is consistent with the original TAM study. Furthermore, compatibility and enjoyment are also identified to significantly affect the students’ adoption of the Kit-Build concept map authoring tool.

∗† Both authors contributed equally to this research.
† Also with Department of Information Engineering, Graduate School of Engineering, Hiroshima University.

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1 INTRODUCTION
Years before the recent Coronavirus pandemic, online and digital learning have been discussed by many educators to support distant learning with digital technologies. However, the pandemic hastens the switch from traditional learning into online education where digital technologies are essential. Additionally, traditional paper-based learning media also have to shift towards online media and digital content. In such a situation, the students and teachers are no longer able to directly interact in a physical classroom. Distance learning becomes an option that challenges educators to adopt innovative and sophisticated educational technology, keeping students’ engagement towards digital learning materials, thus accomplish the expected learning outcomes.

Concept mapping is a known great way to visualize knowledge by connecting concepts or information with the relevant relationship. It can be used as a tool to evaluate, self-assess, track students’ understanding of learning materials [12], and improve their critical thinking skills [17]. It also helps the teachers evaluate the teaching and identify students’ misconceptions and missing concepts [28].
Innovation in digitized concept mapping from the traditional pencil and paper to portable computers and mobile devices allows the students to easily create, modify, and arrange their concept maps [9, 18]. Furthermore, this type of digital technology enables students to improve their independent learning process at their own pace and minimize teacher’s supervision or feedback during learning. With a computer-supported concept mapping, learning activities can be made digital, interactive, and dynamic [6].

A computer-supported concept mapping tool, namely Kit-Build (KB) concept map [23], has been developed to support the online learning environment with concept maps. With the Kit-Build concept map, the students’ can express their understanding by reconstructing concept maps from a set of concept map components. However, the concept map authoring tool has been extended further, which semi-automatically extracts and suggests keywords and propositions. Hence, the tool supports the students in creating the concept maps more efficiently.

The support extension has a different interaction with the tool during concept mapping. It is interesting to analyze the students’ intentions and perceptions of whether they accept using the Kit-Build concept map authoring tool as a learning media that supports them in studying learning materials with concept maps. Technology Acceptance Model (TAM) has been profoundly used to measure and depict users’ acceptance of new systems or technologies, including education and learning technologies [26]. A critical review of TAM revealed that an extension model by including additional factors to the original model is required to provide a broader view and better explanation regarding factors that might contribute to the acceptance of a specific technology [29]. This study explores TAM’s validity in an educational setting and the extent to which the external variables to the model will impact the students’ acceptance towards the Kit-Build concept map authoring tool. This study contributes to suggesting some recommendations as a base reference for future improvement and development of the Kit-Build concept map authoring tool and also contributes as a reference for similar acceptance research involving the TAM model.

2 LITERATURE REVIEW

2.1 Concept Mapping with Kit-Build Concept Map Authoring Tool

Concept mapping is one of many learning approaches that the students can use during learning. Many research shows that concept maps in learning have many advantages to students’ cognitive outcomes. In learning with concept maps, the students have options to do the concept mapping. Either they create the concept maps from scratch (scratch-mapping) or use a close-ended concept mapping approach where they reconstruct concept maps from concept map components. When a student reconstructs a concept map from a given component, their concept mapping activities are often called by kit-building. Therefore, a learning approach that incorporates kit-building activities is called the Kit-Build method.

A Kit-Build kit, or called a kit, is essentially a set of concept map components that the students use to represent their understanding in the forms of a concept map. [23] In Kit-Build, the teacher creates a concept map, which will be decomposed into kits for the students to reconstruct before the learning activities begin. The concept mapping activities put additional load on the teachers as they already have other academic loads to prepare the learning material before the class begins. Prior research also said that concept mapping activity put some additional cognitive load for both student and teacher [15, 16]. They might already have other academic loads before they carry out the concept mapping activities.

Before this research, several studies develop computer-based concept mapping tools that allow people to draw a digital concept map using a computer or tablet instead of traditionally using paper and pencil [6]. The Kit-Build concept map framework also uses a computer-supported tool in its learning environment with concept maps. However, several differences make the Kit-Build concept maps differ from other concept maps. For example, in the Kit-Build concept map, one relationship can only connect to two concepts, and the propositions made with the link can either be directed or non-directed. Additionally, in the recent extension to the Kit-Build concept map authoring tool, it incorporates artificial intelligence to extract concepts and relationships from English texts, hence supports the students to identify concepts and relationships from the texts quickly.

2.2 Technology Acceptance Model

The Technology Acceptance Model (TAM) was first introduced by Davis [7] to identify factors that affect users’ acceptance in adopting new technology. Davis proposed TAM based on users’ social psychological factors rather than on a technology’s technological aspect. The TAM model is coming from the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB) that focused on a link between intention and behavior, in which intention is being predicted by attitudes [1, 21].

Intuitively speaking, the easier the use, the technology will be more acceptable for users. Perceived usefulness (PU) and perceived ease of use (PEOU) are two beliefs that are well-known in the TAM [7, 8]. The former referred to what extent a technology subjectively perceived to be useful for users to improve their productivity and efficiency [20]. The latter referred to what extent users subjectively perceived the ease of use of a technology [7, 8]. The TAM model has been extensively adopted and extended to over 4,000 times by various researchers [13], including technology acceptance from the perspective of educational technology.

2.3 Compatibility, Habit, and Enjoyment as the External Variables of TAM

Some researchers argued that the TAM variables are a subset of the Innovation Diffusion Theory (IDT) [27]. IDT is a concept to explain the importance of innovation in developing science or technology in a society [25]. Compatibility is one of the main characteristics in IDT, which measures "the degree to which the innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" [4, 25, 27]. Additionally, researchers have been demonstrated to include compatibility with their proposed model. The inclusion shows positive effects on behavioral intention through perceived usefulness and ease of use [4, 5, 10, 27].

From the Theory of Interpersonal Behavior (TIB) [30], habit is traditionally defined as “behavior that has become automatized” [10]. Regarding the literature, the adoption of new technology
will complement users’ habits when they experience the necessary knowledge about the purposes of using the technology and by what means they can achieve the goals [2]. Furthermore, habit is activated by the task’s goals for which the system is used in response to a specific learning purpose. Habit is used as a construct in research conducted by [14]. He proposed that variable habit has a significant positive relationship to perceived usefulness and perceived ease of use, which are the primary constructs of TAM, and acts as a principal predictor of future behavior intention of using a technology [2, 24]. This research puts habit into consideration as the tool provides an automated extraction and identification of concepts and propositions from English texts.

Enjoyment is defined as: “the extent to which the activity of using the system is perceived to be enjoyable in its own right aside from the instrumental value of the technology” [8]. Enjoyment is classified as a type of intrinsic motivation. Intrinsic motivation refers to “the performance of an activity for no apparent reinforcement other than the process of performing the activity per se” [20]. Intuitively speaking, in the context of technology acceptance, enjoyment can lower the cognitive burden when using technology. Users are more likely to adopt a technology if they experience enjoyment from using it [22]. Previous research has proven that perceived enjoyment positively affects perceived usefulness and perceived ease of use and plays a significant role in accepting educational technology [3, 11, 22].

3 METHODOLOGY
This research’s proposed model is coming from the original TAM that includes the Perceived Usefulness, Perceived Ease of Use, Attitude towards Using, and Behavioral Intention factors. The research’s conceptual model was proposed based on the presented literature review, including the impact of compatibility, habit, and enjoyment towards the students’ perceived usefulness (PU) and perceived ease of use (PEOU). The proposed model of TAM in regards to the Kit-Build concept map authoring tool and the tested hypotheses of this research are depicted in Figure 1.

![Figure 1: The TAM model with three proposed external variables.](image)

3.1 Hypotheses
Per the literature review and alongside with the original TAM, the proposed model in this research tests the following hypotheses:

- H1 Perceived Usefulness will significantly influence students’ Attitude to use KB to create a concept map.
- H2 Perceived Ease of Use will significantly influence students’ Attitude to use KB to create a concept map.
- H3 Perceived Usefulness will significantly influence students’ Behavioral Intention to use KB to create concept map.
- H4 Students’ Attitude towards use of KB will significantly influence their Behavioral Intention to create a concept map using KB.
- H5 Perceived Ease of Use will significantly influence students’ Perceived Usefulness to use KB to create a concept map.
- H6 Students’ work Compatibility will significantly influence students’ Perceived Usefulness in using KB to create concept map.
- H7 Students’ work Enjoyment will significantly influence students’ Perceived Usefulness in using KB to create a concept map.
- H8 Students’ Habit in using tools to create concept map will significantly influence students’ Perceived Usefulness.
- H9 Students’ Habit in using tools to create concept map will significantly influence students’ Perceived Ease of Use.
- H10 Students’ work Enjoyment will significantly influence students’ Perceived Ease of Use in using KB to create a concept map.
- H11 Students’ work Compatibility will significantly influence students’ Perceived Ease of Use in using KB to create concept map.

The term KB in the defined hypotheses refers to the Kit-Build concept map tool instead of the Kit-Build method.

3.2 Data Collection, Context, and Participants
This research aims to observe the students’ acceptance of using the Kit-Build concept map authoring tool to support their learning process in understanding English reading comprehension texts in the form of concept mapping. Therefore, the participants are required to have a minimum TOEFL score of 450 and are familiar with using a web-based online application. The requirements are set to minimize problems while using the concept mapping tools, and they could read and understand basic English. The participants were selected based on their voluntary participation and a preliminary demographic questionnaire. About 76 undergraduate students were voluntarily participating in the experiment, but only 73 students were able to participate fully. They were currently in the 3rd year of their study. During the experiment, they were given several English readings, and they were asked to create concept maps that comprehensively depict their understanding of the readings.

After the participants finished creating concept maps using the tool, they were given a 7-Likert scale TAM questionnaire with 15 items representing the four main TAM variables and 11 additional items representing the three external variables defined in this research. The TAM variables include the Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Attitude Towards Using (AT), and Behavioral Intention (BI). The additional external variables include...
Compatibility (C), Habit (H), and Enjoyment (E). The additional variables represent external variables for the proposed model. Samples of the TAM questionnaire items used in this research are shown in Table 1. The term Kit-Build in the TAM questionnaire items refers to the Kit-Build concept map authoring tool.

3.3 Validity and Reliability

Before analyzing the students’ response data, the questionnaire items’ internal consistency was validated by calculating each variable Cronbach’s alpha to depict its reliability. The summary of the reliability analysis of the items in the questionnaire is presented in Table 2. The results indicated that the alpha of Perceived Usefulness (PU) was 0.83, both Perceived Ease of Use (PEOU) and Attitude Towards Using (AT) were 0.85, Behavioral Intention (BI) was 0.91. Whereas, additional variables’ alpha, such as Habit (H) and Enjoyment (E) fall between 0.8 to 0.9, hence indicating good reliability. However, Compatibility (C) has an alpha of 0.79 that indicates its reliability was still acceptable. An alpha higher than 0.9 indicates excellent reliability. The resulting alpha implies that the responses towards a set of questions for all variables are reliable. Hence, the response data can be analyzed to evaluate and test the hypotheses further.

Table 2: TAM questionnaire Cronbach’s Alpha

<table>
<thead>
<tr>
<th>TAM Variables</th>
<th>Items</th>
<th>Cronbach’s Alpha</th>
<th>Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEOU</td>
<td>4</td>
<td>0.85</td>
<td>Good</td>
</tr>
<tr>
<td>PU</td>
<td>5</td>
<td>0.83</td>
<td>Good</td>
</tr>
<tr>
<td>AT</td>
<td>4</td>
<td>0.85</td>
<td>Good</td>
</tr>
<tr>
<td>BI</td>
<td>2</td>
<td>0.91</td>
<td>Excellent</td>
</tr>
<tr>
<td>C</td>
<td>4</td>
<td>0.79</td>
<td>Acceptable</td>
</tr>
<tr>
<td>H</td>
<td>4</td>
<td>0.87</td>
<td>Good</td>
</tr>
<tr>
<td>E</td>
<td>3</td>
<td>0.9</td>
<td>Excellent</td>
</tr>
</tbody>
</table>

Notes: The term Kit-Build refers to the Kit-Build concept map authoring tool.

4 RESULTS AND DISCUSSION

A conceptual model, namely TAM, was used in this research to evaluate students’ acceptance towards the supported KB concept mapping tool. In this section, the effect among variables in the proposed conceptual model is presented and analyzed through a statistical approach. However, the resulting questionnaire data fail to conform to the Shapiro-Wilk test for normality. Therefore, the non-parametric test will be used to evaluate and test the hypotheses.

In summary, the regression analysis result for the proposed acceptance model is depicted in Table 3. The hypotheses were tested with a 5% significance level to consider whether to accept the null hypothesis. If null hypotheses are rejected, it means that there is significant influence between the corresponding variables. This research uses a non-parametric Generalized Linear Model (GLM) to test the hypotheses and uses the Nagelkerke’s pseudo-$R^2$ to depict the fitness of the model. The summary of the GLM analysis result of the model is shown in Table 3.

Table 3: Summary of Hypotheses Tests

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Coefficient</th>
<th>p-value</th>
<th>Intercept</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1: PU $\rightarrow$ AT</td>
<td>0.712</td>
<td>***</td>
<td>1.694</td>
<td>0.533</td>
</tr>
<tr>
<td>H2: PEOU $\rightarrow$ AT</td>
<td>0.005</td>
<td>*</td>
<td>0.199</td>
<td>0.469</td>
</tr>
<tr>
<td>H3: PU $\rightarrow$ BI</td>
<td>0.425</td>
<td>*</td>
<td>0.640</td>
<td>0.618</td>
</tr>
<tr>
<td>H4: AT $\rightarrow$ BI</td>
<td>0.456</td>
<td>*</td>
<td>0.297</td>
<td></td>
</tr>
<tr>
<td>H5: PEOU $\rightarrow$ PU</td>
<td>0.399</td>
<td>***</td>
<td>2.761</td>
<td>0.328</td>
</tr>
<tr>
<td>H6: C $\rightarrow$ PU</td>
<td>0.241</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H7: E $\rightarrow$ PU</td>
<td>0.217</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H8: H $\rightarrow$ PEOU</td>
<td>0.160</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H9: H $\rightarrow$ PEOU</td>
<td>0.116</td>
<td>0.087</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H10: E $\rightarrow$ PEOU</td>
<td>0.228</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H11: C $\rightarrow$ PEOU</td>
<td>0.207</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

***: p-value < 0.001; **: p-value < 0.01; *: p-value < 0.05; p-value higher than 0.05 denotes non-significant items

A non-parametric GLM analysis was incorporated to evaluate the students’ responses towards the model. The analysis depicts how each independent variable influences or predicts the dependent variable. The $R^2$ value represents the proportion of relationship variance between dependent and independent variables explained by the model. Hypotheses H1 and H2 depict the AT variable that dependent on PU and PEOU. Based on the multiple regression analysis results of PU and PEOU towards AT, PU is significantly influenced AT, but not PEOU. The influence of PU towards AT is also shown to be statistically significant. However, based on the obtained $R^2$ value, the model covers 53.3% of the AT variance.

The relationship between PU and AT towards behavioral intention to use (BI) was also evaluated using the GLM analysis. This analysis was carried out to predict BI from PU and AT. The analysis result shows that both PU and AT can predict BI as the linear regression analysis shows a statistically significant result ($p$-value < 0.05). Both PU and AT give a relatively equal effect towards BI, as they have quite a similar coefficient value of 0.425 and 0.456, respectively. Several factors with a similar coefficient value mean that all factors
have a similar influence level to a target factor. According to the regression result, the $R^2$ value of 0.469 implies that 46.9% variance of BI is explained by PU and AT. However, the interaction model analysis predicts better than an individual linear model analysis, which considers only the AT or PU variable. If BI is predicted by AT and PU individually, the analysis yields an $R^2$ value of 0.4119 and 0.3965, respectively. As the individual analysis yields a lower coefficient value, it can be said that both AT and PU together produce a more significant influence towards BI.

The three proposed additional external variables, i.e., Compatibility (C), Habit (H), and enjoyment (E), were taken into account, along with the PEOU to identify whether these variables are affecting the PU variable through the GLM analysis. The result shows an $R^2$ value of 0.618, which implies 61.8% of PU’s variance, can be predicted by C, H, E, and PEOU variables. Except for Habit (H), all of the external variables and PEOU are shown to influence PU. The GLM analysis shows that H has a $p$-value of 0.297, which is statistically insignificant as its value is higher than the 0.05 significance level. Therefore, it can be said that the students’ habit does not influence their perceived usefulness of the tool. They do not consider their habit in concept mapping will influence their perceived usefulness of the tool. However, as the remaining variables have $p$-values of less than 0.05, the students’ compatibility, enjoyment, and perceived ease of use towards using the tool are found to influence their perceived usefulness. Furthermore, the students’ perceived ease of use has the most considerable influence on students’ perceived usefulness, followed by their compatibility and enjoyment of using the tool.

Similarly to the previous analysis, the effect of the external variables C, H, and E towards PEOU is also evaluated using the GLM analysis. The $F$-test’s significance indicates that the sample data have sufficient evidence to fit the regression model rather than a model without the independent variables with a $p$-value of 0.000 that is less than the specified significance level of 0.05. Even though the test result shows that all of the external variables can predict only 32.8% of the PEOU variance, both C and E variables influence the students’ PEOU. Like in the PU analysis, the students’ habit does not influence their perceived ease of use of using the tool. Consolidating all of the GLM analysis results and disregarding all insignificant associations and relationships, the students’ acceptance model of the Kit-Build concept map authoring tool of this research is shown in Figure 2.

In many social science settings, some studies have an inherently more considerable amount of unexplained variation. Any field related to predicting human behavior, such as psychology, like a study about human behavior or acceptance towards new technology, typically has $R^2$ values lower than 50% [19]. This research also shows the low value of $R^2$ that happens due to higher variability around the regression line. Our findings indicate that human behaviors in learning using concept maps are hard to predict. Hence, the resulting data are relatively noisy. Nevertheless, the result mostly fits the proposed model, as most regression analysis results towards the model fall below the statistical significance level of 0.05.

The overall result shows that most of the relationships conform to the previous TAM research to depict students’ intention in using new technology. In this study, the students’ perceived usefulness is positively affecting their attitude towards using the tool. On the contrary, their perceived ease of use shows statistically insignificant results towards their attitude towards using the tool. Hence, if they think that the tool is useful, they will still use it regardless of how they think about the tools’ ease of use level.

Other research claimed that habit is an unconscious behavior, which is learned through repetition [2]. Regardless of the students’ prior habit in concept mapping, as long as the tool is enjoyable and compatible with their previous work, they will perceive that the kit is easy to use and useful to help them make a concept map. Hence, they will use the tool when they learn English reading comprehension material. However, the finding does not support the result found in [14, 24].

As the tool is considered new to the students, they might need to familiarize themselves with the concept mapping tool to utilize it fully. However, based on the results, the students’ attitude towards using the tool was not influenced by the students’ perceived ease of use. Their attitude towards using the tool is greatly influenced by their perceived usefulness of using the tool. The result implies that the students’ will continue using the tool to help them understand the English learning materials through concept mapping regardless of their perceived ease of use in using the tool. Most students do not mind learning and using a new concept mapping tool to support them in studying English reading comprehension with concept maps.

According to the result, to let the students use the tool more during their learning, it has to be enjoyable to use and be compatible with their learning context. Furthermore, the students’ perceived usefulness towards the concept map authoring tool plays an essential role as the only factor influencing their intention to adopt the Kit-Build concept map authoring tool the most. Additionally, as
the students had experienced that using the tool to create concept maps is easy, they will perceive that the tool is useful. Thus, the students’ perceived ease of use indirectly influences their intention to use the Kit-Build concept map authoring tool.

4.1 Limitation

The acceptance being evaluated in this research captures the students’ impression when using the concept mapping tool. Based on the questionnaire results given to the students, their experiences in using a computer-supported concept mapping tool may be limited. Before this experiment, they do not usually use a computer-concept mapping tool or have any previous experience using the Kit-Build method in their daily learning activities. Before being introduced to the Kit-Build method and its tool, most of the students already know about concept maps and have several concept mapping experiences. Previously, most students use a traditional pencil and paper or other digital methods that allow them to take some notes or draw concept maps during learning. Hence, many of them were new to the Kit-Build concept mapping tool and the Kit-Build method.

Due to the specific and limited number of participants, the results presented in this research may not cover the expected target and also difficult to generalize or interpret as uncovered and voluntary bias may occur. Some of the analyzed data fail to conform to the classical statistical tests. Therefore, extra care must be taken in interpreting and generalizing the result of this research.

5 CONCLUSION AND FUTURE WORKS

In general, the students accept to use the Kit-Build concept mapping tool to help them learn and comprehend English reading comprehension through concept mapping. It also can be said that the tool helps them create concept maps from scratch and reconstruct a concept map from a given kit. Additionally, even though this research limits the use of the concept mapping tool to accept English reading comprehension texts, there is a possibility that the tool can also support the concept map creation activities from other English text-based learning materials.

The proposed TAM model used in this research mostly conforms to the original TAM, as previously introduced by Davis. In this research experiment, the students’ perceived ease of use does not influence their attitude towards using this research’s concept mapping tool. Furthermore, among the three additional external variables, i.e., compatibility, habit, and enjoyment, which were included in the proposed model, habit is the only aspect that has no significant effect on students’ intention to use the tool to create a concept map. Therefore, to improve the students’ acceptance in using the Kit-Build concept map authoring tool, the tool should improve its suggestions’ quality and usability. Improving the quality and the usability of the tool could raise its usefulness in supporting the students create concept maps from English reading comprehension texts.

The TAM analysis results of this research identify aspects that influence the students’ intention to use the Kit-Build concept mapping tool to learn EFL reading comprehension. This research experiment results show that future improvements to the authoring tool can also be made, focusing on aspects that influence the most and less prioritizing factors that less-influence another factor. A further usability analysis can also be carried out to evaluate and analyze the concept map authoring tool’s user experience.

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