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The Use of Digital Annotation Tools in Assisting Reading English for Science and Technology Academic Texts among L2 Learners in Higher Institutions

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ABSTRACT

Since more academic reading resources are becoming digitally available, second language (L2) learners at higher institutions are confronted with more obstacles than in the past. Despite this, the abundance of internet resources available to support reading has made reading a more engaging activity. This research examined L2 learners' usage of digital annotation tools (DAT) in a Learning Management System (LMS) to aid the reading of English for Science and Technology (EST) materials in a blended course. The data was collected from a sample of 55 students who were enrolled in a variety of Science and Technology courses at a public institution in Malaysia. The data was gathered through online annotation and focus group interviews and subsequently subjected to thematic analysis using the NVivo software program. The validation of the thematic analysis was conducted through the utilisation of Cohen's Kappa analysis, resulting in a score that approached near perfection. This outcome serves as evidence for the credibility and accuracy of the collected data. Findings revealed that digital annotation tools improved L2 learners' lexical recognition and comprehension. Highlighting and annotating texts showed learners could summarise, justify, reproduce, and rephrase concepts. These annotation analyses supported interview data, showing that learners developed cognitive skills by paraphrasing and synthesising EST academic texts online. This study suggested facilitating successful best practices in online reading settings, where DAT is important in subject content areas for higher education students. This matters because DAT improves L2 learners' cognitive and social development by improving English reading comprehension.

Keywords: English for Science and Technology; Online Reading; Digital Annotation Tools; Learning Management Systems; higher institution

INTRODUCTION

Reading scientific texts with understanding involves a complex cognitive process to construct and derive meaning. In the context of second language reading, many English as a Second Language (ESL) learners may perceive the act of reading English academic literature as a formidable undertaking. This is evident in the eye movement research conducted by Sulaiman et al. (2020), which revealed that ESL undergraduates fixated longer on the initial reading of the academic text. They asserted that regardless of language proficiency and background knowledge, ESL undergraduates still require assistance in reading English academic texts.

On top of that, with the advancement of technology, reading from screens or electronic sources also called digital reading, has become increasingly prevalent for both educational and recreational reading (Hyman et al., 2014). This new norm of reading has influenced learners' reading styles and strategies to engage with the reading materials for comprehension as well as to access information. Most of the reading materials are in digitalised form, such as e-textbooks and e-journals. To be updated on current research in any discipline, university students need to be alert to newly published research articles that are generally available online. Hence, online reading, which also includes searching and browsing, takes a new perspective in terms of learners' interaction with the text to achieve comprehension.

The use of online reading tools, such as digital annotation tools, facilitates reading that assists learners' reading comprehension in an online learning environment (Ruhil Amal et al., 2020). Annotation can illustrate learners' interaction with the texts by highlighting, underlining, circling, or summarising- words, comments, or content in the text to construct understanding. However, annotations might not be a common literacy practice among university students, especially in an online reading environment (Park et al., 2014). Hence, there is a need to assess the processes involved in utilising digital annotation tools among university students to achieve comprehension.

The process of decoding, which involves the precise and fluent recognition and pronunciation of words, presents a significant obstacle for L2 learners when it comes to reading. L2 learners may face difficulties when confronted with foreign vocabulary or intricate sentence constructions, leading to challenges in deciphering the intended meaning. Consequently, this issue with decoding might impede their overall reading comprehension abilities (Sulaiman et al., 2020). Similarly, challenges have arisen in the context of online reading. The act of decoding letters or words on hypertexts is seen as necessary for online or hypertext reading, which is viewed as a challenging task.

According to Sung et al. (2015), online reading has evolved from traditional forms, such as reading newspapers, books, and magazines, to non-traditional forms, such as reading videos, hyperlinks, and noises. The concepts or notions are given in a non-linear arrangement, allowing readers to read in whatever order they choose. In general, hypertexts do not adhere to a certain order of reading, allowing users to read in a non-linear fashion and transfer offline reading skills to online reading (Akyel & Erçetin, 2009). This suggests that online reading is a distinct activity, as it differs from traditional printed text reading in that readers can read not only traditional electronic texts but also resources in an online environment. Yet, this also implies that to successfully read online resources in a variety of formats, readers must possess an understanding of effective reading strategies. Hence, this study aims to examine the use of digital annotation tools to assist in the reading of academic EST texts among Malaysian university students.

LITERATURE REVIEW

ONLINE READING

The term "online reading" pertains to the practice of engaging with written material in a digital format, which is made accessible and consumed via internet-connected devices. The activity encompasses the consumption of diverse digital textual formats, including but not limited to articles, blogs, websites, e-books, online forums, social media posts, and digital publications. The act of reading online frequently entails engaging with hyperlinks, multimedia components (such as images, videos, and audio), and interactive functionalities that are integrated into the digital text (Akyel & Erçetin, 2009). Online reading encompasses a range of potential benefits as well as obstacles. Digital texts provide interactive and multimedia elements that have the potential to boost both engagement and comprehension (Lai & Lin, 2020). In contrast, the act of reading online necessitates the reader's ability to effectively navigate through copious quantities of information, critically assess the reliability of sources, and effectively handle any distractions (Ruhil Amal et al., 2023).

One of the initial analyses on online reading highlights the significance of digital literacy competencies, encompassing the aptitude to effectively navigate, assess, and integrate online information. For example, a study was undertaken by Badrasawi et al. (2017) on university students to explore the hierarchical pattern of reading skills. The results indicated that there were variations in difficulty among different context types, skill areas, and text kinds, with items that necessitated comprehension and interpretation being more challenging. Park et al. (2014) investigated how university students generate meaning when reading online using information-seeking strategies and decision-making processes by expanding the cognitive flexibility theory. They discovered that cognitive flexibility is indicated by multiple knowledge gains, diverse information searches, and the capacity to utilise online resources. Students were able to exercise metacognitive flexibility by synthesising knowledge from numerous online resources to gain a grasp of phrases or concepts they encountered. Students were also able to widen their breadth of information search by deriving meaning from a variety of online resources and improving their own computer search skills.

DIGITAL ANNOTATION TOOLS

A Digital Annotation Tool (henceforth, DAT) refers to software or applications that enable users to annotate and mark up digital content electronically. This functionality allows users to engage with digital content, such as words, photographs, or multimedia elements, by incorporating comments, highlights, drawings, symbols, or other forms of annotations directly into the material. These tools frequently include a variety of features and functionalities to facilitate the process of annotation. These include several pen and highlighting choices, text boxes, shapes, and the capability to associate annotations with specific portions or references within the document.

Numerous scholarly investigations underscore the advantages associated with the utilisation of digital annotation technologies. In the context of online education, these platforms play a crucial role in promoting collaborative learning, facilitating the development of knowledge, and enabling the sharing of information (Liu & Cao, 2018; Winchell et al., 2020). Digital annotation tools have been found to have a positive impact on students' reading comprehension since they facilitate the development of active reading behaviours, metacognitive awareness, and critical thinking abilities (Ruhil Amal et al., 2023). Additionally, these platforms offer users the

advantages of flexibility, simplicity, and searchability, hence enhancing their ability to efficiently organise and access annotated content (Lai & Lin, 2020; Ponce et al., 2022). These studies present empirical evidence that substantiates the beneficial effects of digital annotation tools on students' reading comprehension.

In Malaysia, previous research among university students on using digital annotation tools in reading English academic texts has also shown promising results for enhancing students' reading comprehension and language skills development. A study by Ruhil Amal et al. (2020) investigated the effects of DAT on Malaysian university students' reading comprehension and found that students who used DATs performed better compared to those who did not. The study also showed that students who used DATs reported improved understanding of the texts and felt more engaged in the reading process. Thus, learners can monitor their understanding of the L2 reading by highlighting the texts (Thoms & Poole, 2017). Similarly, Ruhil Amal et al. (2022) explored ESL learners' utilisation of Online Discussion Forums (ODFs) in Interactive Reading for Academic Disciplines (iREAD) to assist in reading online scientific texts within an English-for Specific Purposes course at a public university. Previous studies have provided evidence of positive results in enhancing learners' reading comprehension and language proficiency, highlighting the advantages of utilising this strategy to support students' reading abilities.

THEORETICAL DISCUSSION

A significant reading model that guided this study is the Interactive Reading Model (Rumelhart, 1977). According to this model, reading combines the action of both bottom-up and top-down processes that recognise lower-level processing skills and higher-level cognitive skills. Rumelhart (1977) noted that written words are stored in the visual information store (VIS) where the key features of the words (bottom-up process) are extracted before the information is sent to a pattern synthesiser. Similarly, in an LMS, the act of reading online materials goes through the same process of understanding the online text, where at the pattern synthesiser, the reader's prior knowledge is used to interpret what is read (top-down process). The key elements in this model are significant in the current study because students interact with the texts by identifying parts of a paragraph or sentence through annotations. This is important because learners comprehend better when they can identify parts of a paragraph. For example, a paragraph normally consists of several sentences that support one main point. Hence, to be successful in reading, ESL learners must be able to identify elements of a paragraph. The ability to identify parts of paragraphs is known to assist students in identifying and understanding the main ideas of a paragraph (Duke & Pearson, 2002). This combination of using annotations and identifying parts of a paragraph structure will assist learners in understanding online texts. Through this process, students can achieve comprehension. This is important for the literacy of ESL students because most students can comprehend a text better if they can easily understand the structure of a paragraph (Lo et al., 2013).

The importance of providing explicit education in these abilities to facilitate proficient online reading is underscored. It is important to identify the need to establish a more coherent way for students to read successfully online. This process should include the combination of a more structured manner in reading materials online with assistance of digital tools. Hence, providing students with significant online reading tools that allows them to navigate online academic texts is a prominent aspect in the current study.

METHODOLOGY

The current study investigated the processes involved in reading EST materials in an online context. This research was conducted in an English for Specific Purposes (ESP) course titled English for Technical Communication (ETC) that utilised DAT in an online reading platform called Interactive Reading for Academic Disciplines (iREAD) for teaching and learning. The online platform offers various digital tools for reading purposes, such as annotations, which are considered important tools. However, only qualitative data was collected and analysed for this study. While the study predominantly gathered qualitative data through annotation analyses and focus group interviews, the integration of a qualitative approach substantially strengthened the findings. Moreover, qualitative study offers a contextual comprehension of the learning environment, considering elements such as learners' origins and their proficiency with digital tools (Creswell & Creswell, 2017). The study achieved a great understanding of the influence of DAT on reading comprehension by prioritising extensive descriptions and qualitative intuition rather than numerical statistics. In qualitative research, intuition helps researchers identify patterns and themes in data, enhancing their understanding of participants' experiences and guiding the interpretation of findings (Hyland, 2016). This approach ultimately informed the development of more effective teaching strategies suited to the needs of L2 learners (Hyland, 2016). The qualitative data included analyses of annotations and Focus Group Interviews (FGI), which will be further explored.

PARTICIPANTS

To gather rich data, the study used a purposeful sampling technique. The term "purposeful sampling" relates to the intentional selection of a sample that investigates the primary idea being examined (Creswell & Plano Clark, 2011). Considering this, a sample of 55 students among 614 students enrolled in English for Technical Communication from diverse Science and Technology programs at a public university was chosen to use the iREAD. However, qualitative data from only 12 students were analysed. The students were chosen based on their level of engagement in the course. This type of behavioural engagement refers to active responses during learning activities and is indicated by participation, persistence, and/or positive conduct (Bond et al., 2020). Based on this aspect, the researcher categorised the students into three main groups: active, intermediate and non-active. Among the 12 students, four students were regarded as active learners (high engagement), four students had an intermediate level of engagement, and the remaining four students were considered non-active learners (low engagement).

All the students were taking the same English course, a university-mandated level 2 English course. To participate in the study, each student was given an informed consent form to sign and return to the researchers. This is to ensure that students understand that their participation is completely voluntary and that there are no consequences for not participating. The English course that the students were enrolled in was a blended course, where they met twice a week for two hours of tutorials and two hours of computer lab. Students were present because they were required to do so for this class. Students were briefed on the research project during the introductory briefing, and they were offered the opportunity to shift to other classrooms if they did not wish to participate. However, none of the students did. Each student was given an acronym to systematically tag them to facilitate data organisation and to ensure anonymity.

INSTRUMENTS

ONLINE READING SYSTEM: iREAD

An online reading application known as Interactive Reading for Academic Disciplines (iREAD) was utilised to collect the data regarding annotations. The system was developed by experts from Universiti Kebangsaan Malaysia (Nor Fariza et al., 2014). The system contains a variety of functionalities, including DAT, discussion forums, and video and audio features, among others. While other LMS also included similar features, iREAD was catered specifically for academic reading. For example, a study using iREAD found that students were able to paraphrase and contextualise ideas by reading public health materials with the use of DAT (Ruhil Amal et al., 2023). In another study, online discussion forums (ODF) used in iREAD enabled students to engage in a more interactive manner, comprehend online materials better and work collaboratively (Ruhil Amal et al., 2022). However, the current study primarily focuses on one of the system's most important components, which is the annotation tools. Two distinguishing features can be found in the annotation tools of iREAD. When using the first feature, students have the option of selecting a variety of colours, such as yellow, red, and green, to highlight information accessible through online reading. The second function enables students to record their notes, thoughts, ideas, and other information pertaining to the subject that has been highlighted.

FOCUS GROUP INTERVIEW PROTOCOLS

Focus group interview (FGI) techniques were one of the tools utilised to gather data. The reason for this selection was that the goal was to gather information from the group and produce a shared understanding that was specific to the study. The objective of the interview protocol was to gain insight into the students' perspectives as a group regarding the utilisation of DAT in iREAD. This was conducted in two small groups, with six students for each group. A small group was selected as the researchers believed that it would create a more focused discussion and interrelated opinions. The researcher formulated the questions, which were subsequently validated by subject matter experts. The FGI protocol includes questions regarding the use of DAT, such as highlighting and annotating text.

ONLINE READING MATERIALS

The selection of materials was taken from the English for Technical Communication module that students were using during the semester. The readability index was used to determine the level of difficulty for each text. This allows the researcher to select the texts based on students' proficiency level. The reading material that was part of the academic module for that semester included topics relevant to technical communication, and as such, the topics that were provided for the students to read online with the assistance of DAT were *Types of Oral Presentation, Guidelines to Effective Presentations* and *Three-part rule for presentation.* Table 1 provides the details of the task, material, and readability index.

TABLE 1. Task in iREAD

Reading Title	Instructions in iREAD	Flesch reading ease
#3 Oral Presentations	As you read Guidelines to Effective Presentations, use the GREEN highlighter to highlight parts of the text and annotate in your OWN words what each step means.	42.9/ Difficult

The readability of the text was 42.9, signifying its inherent complexity and the consequent difficulty in comprehending its content. The readability index had no distinct connection with the annotation tasks. However, the objective of selecting reading materials of appropriate level was to ensure that the online reading materials that students were reading or analysing were either their reading level or one level higher. The task required the students to highlight the text and then annotate it using their own expressions, showcasing their understanding of each point made. Figure 1 illustrates the main page in Week 4 and the activity on Page 3, from which the data was collected through annotations.

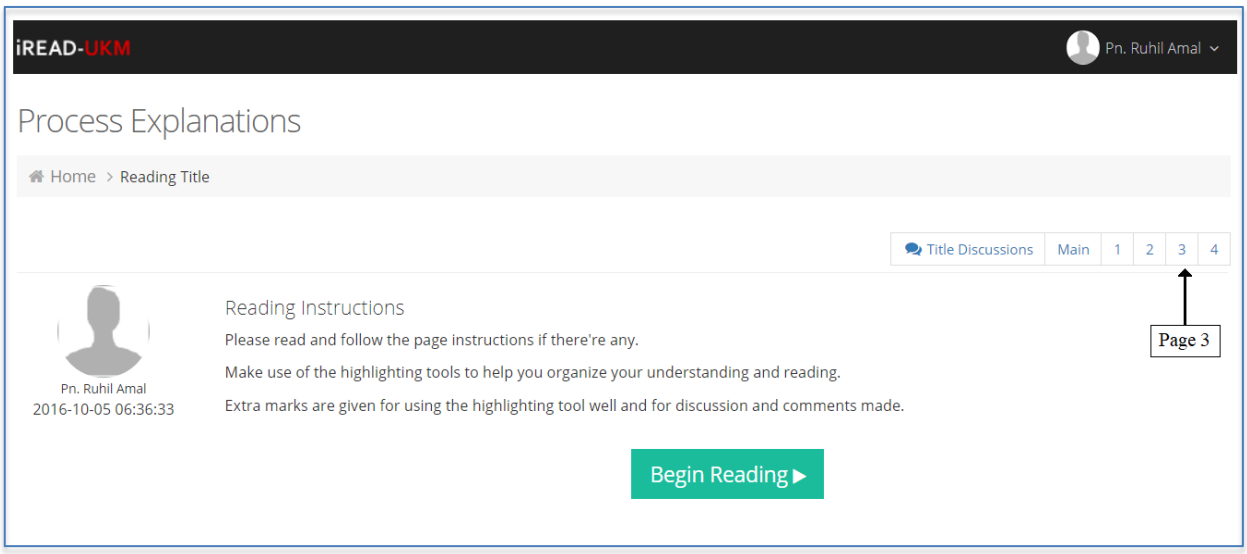


FIGURE 1. Screenshot of the main page

As illustrated in Figure 1, students were required to do several tasks. However, data on students' annotations was collected from reading Title #3 only, as highlighted.

DATA COLLECTION PROCEDURES

Qualitative data was collected from students' annotations based on highlighted texts and the reproduction of ideas. In doing this, the utilisation of annotation tools involves four main procedures, as illustrated in Figure 2. The initial action involves highlighting the element. Subsequently, the user can choose the desired colour for highlighting the text, which can be either yellow, green, or red. However, for this task, the students were required to choose green to highlight parts of the texts. Following this, the user should input the desired text to be highlighted based on the guidelines given by the system. Finally, the user needs to click the save button to store the information that has been saved. Figure 2 illustrates the four indicated steps.

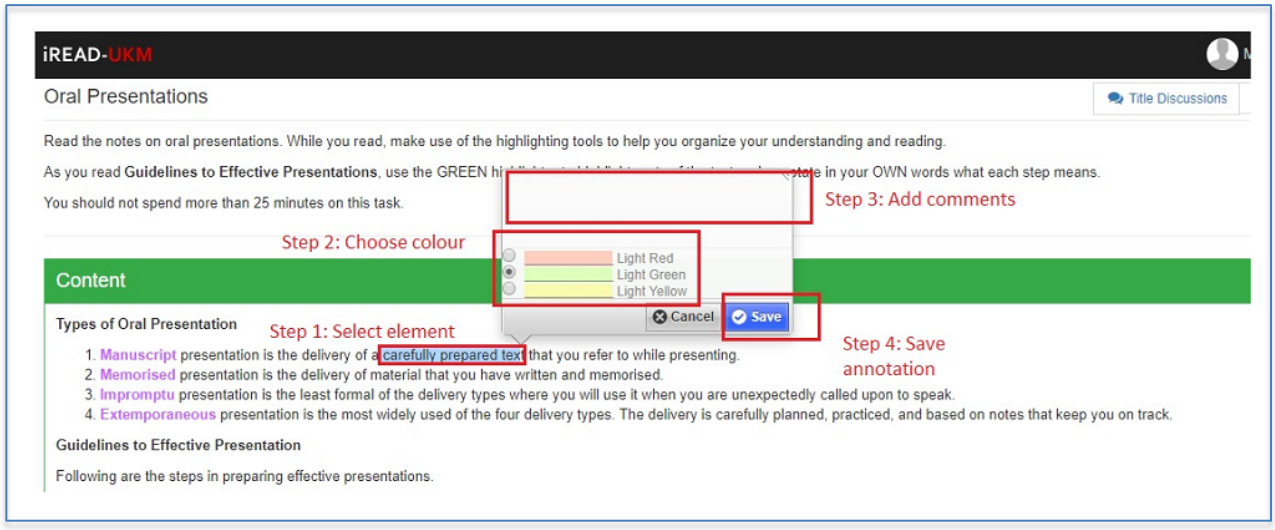


FIGURE 2. Screenshot of annotation process involved in iREAD

DATA ANALYSIS

The study employed thematic analysis, as proposed by Creswell (2014), to analyse the data. Creswell (2014) outlines a six-stage process for analysing qualitative data. The methods encompassed in this study involve the collection and organisation of data, the exploration of data through coding, the identification of theme development, the representation of themes in narrative format, the interpretation of the findings, and the verification of the accuracy of the findings. Based on the created themes, data were validated using Cohen Kappa inter-rater reliability analysis. The calculation yielded a K value of 0.7, which not only confirms the high dependability or reliability of the data analysis but also indicates a significant level of agreement, indicating the annotation data and interview data were of high reliability.

FINDINGS AND DISCUSSIONS

The findings of this study highlighted the annotation process made by 12 students as well as their opinions on the use of DAT in the online reading platform named iREAD.

LEXICAL RECOGNITION

Most of the students believe that the annotation tool in iREAD facilitated lexical recognition as students were able to identify main points and keywords in paragraphs easily (as depicted in words and phrases which are in bold) based on the topic *guidelines to effective presentations* (refer to Table 1). For example, as reported from the interview in Excerpt 1:

Excerpt 1

Student E	**Personally, I feel that highlighting is quite useful for me to know directly the key points without reading the whole text a second time.**
Student T	It is more useful because **it can highlight directly** compare to others because others cannot highlight the main points or we cannot just simply add in some points as u want. So iREAD can add in and **highlight the main points or key words** and add in the annotation that you want…It can help me to find the **main idea and supporting details** very fast.

Excerpt 1 is presented by a pair of students who assert that the utilisation of annotation tools facilitated the process of highlighting pertinent information within the text, hence enabling the identification of main ideas or key terms within the paragraph. They believe that the utilisation of annotation tools allowed them to concentrate on the highlighted words without having to read the entire passage to understand the main idea of the passage. This finding is supported by the Interactive Reading Model (Rumelhart, 1977), which asserts that readers will comprehend better when they can identify parts of a paragraph. Highlighting was considered a learning technique (Dunlosky et al., 2013) employed by learners with the intention of sustaining the memory of textual information (Mason et al., 2023). Hence, it is worth noting that annotation tools assist learners in selecting information with the aim of understanding the content better. This is also evident in Excerpt 2, which illustrates interview extracts from four students.

Excerpt 2

Student L	**Really helps because we can easily find the main points or main idea of the passage or the text. Makes my reading faster.**
Student G	Just like the passage from paragraph 1, if I highlight the important points, then when **I refer back**, maybe I see the highlighted parts. I **know the main idea** is there, so I know what the paragraph is about.
Student K	We **can easily understand the main point** that we need to take from the passage. So, we can just summarise all the main points, and then we can know what the passage says. It is clearer when reading the text.
Student C	For the past activity, we really enjoyed highlighting the main point; we will easily understand **which part is the main point.**

Excerpt 2 reflects four students' beliefs that highlighting is significant to identify key parts of an online material. This allows students to see the logical links made by the author and identify the main idea. This identification of text structures is important to achieve comprehension (Lo et al., 2013).

IDENTIFY RELEVANT INFORMATION

The students also believe that when using DAT, they were able to identify relevant information faster and recognise specific words used in academic reading. This learner-generated highlighting was found to be more effective for college students as compared to school students, as reported by Ponce et al. (2022), as college students can distinguish the more relevant information from the less relevant. As such, the use of annotation tools assisted students in doing so. Excerpt 3 elaborates on this point:

Excerpt 3

Student I	**For me, I enjoy it (using annotations). Because of that, we can learn some specific words to describe the technical description. It gives us a lot of advantages, such as allowing us to recognise specific terms or words. We can know the specific words. Also, we can learn new terms.**
Student E	Maybe some of the words or key-points we do not understand we **can annotate it**, …and maybe we can rephrase it to understand better.

In Excerpt 3, Student I shared his experience in reading with the assistance of DAT. Here, the annotation tool introduced him to specific words or terms of a technical description. In relation to this, Student E found it easier to find the meanings because the new words or terms were highlighted clearly with the use of the annotation tools. The responses in Excerpts 1 – 3 illustrate that annotation tools are important tools that assist in reading EST online materials. The subjects describe it as assisting them in identifying the main ideas or keywords of online materials.

To validate students' ability to achieve lexical recognition and identify relevant information, the researchers analysed student's annotations in Week 4 lesson on Presentation Skills, activity #3 Oral Presentations: Guidelines to Effective Presentations (see Table 1) in iREAD.

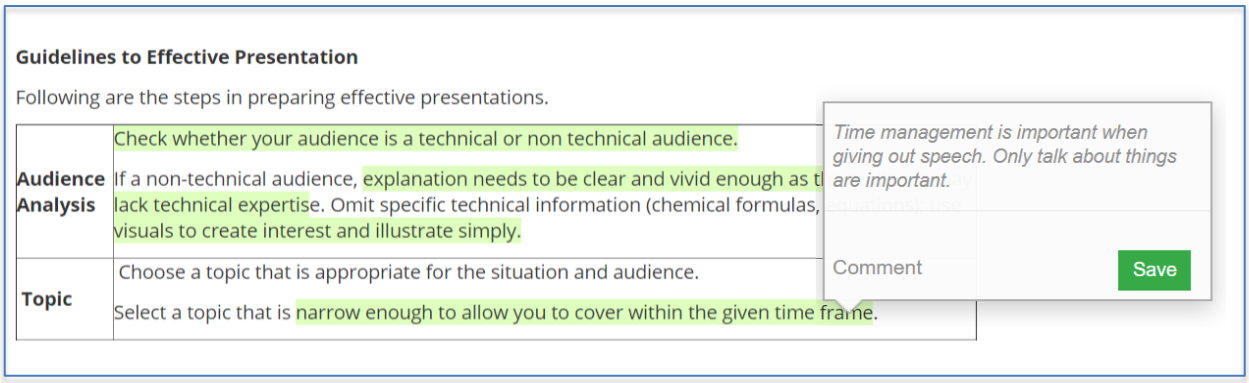
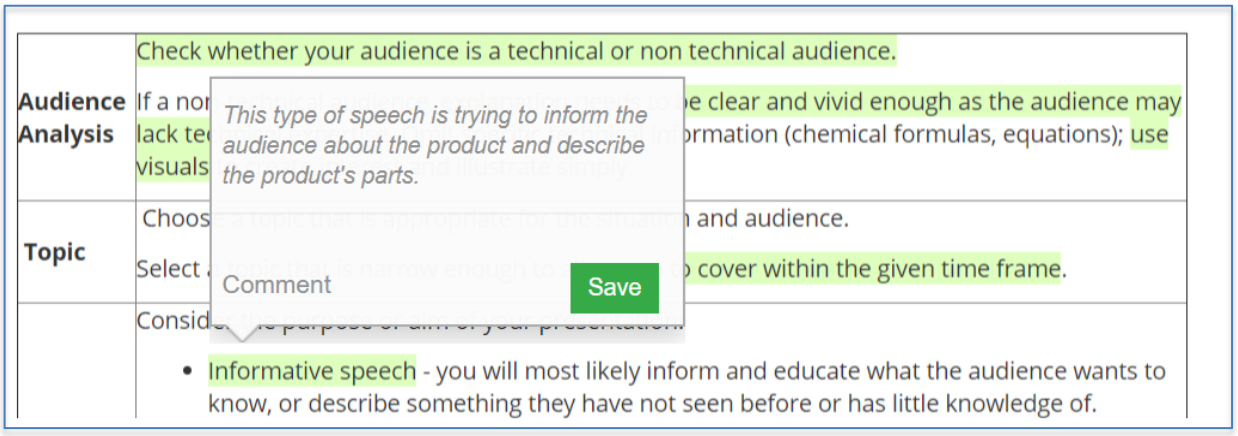


FIGURE 3. Screenshot of annotation no. 1 by Student L

Figure 3 demonstrates an example of annotations made by Student L. Student L was able to reproduce the main ideas of the text by including additional information and justifying ideas for the highlighted texts. For example, he showed his understanding of the point of 'topic' selection because he related the topic to time management. This supported his claim in the interview in Excerpt 1, where he stated he could '*easily find the main points or main idea of the passage or the text',* enabling him to summarise the main idea. In addition, *'Only talk about things that are important'* reflected that Student L was able to include his own reflections on the text. This aligns with a study by Winchell et al. (2020), which found that highlighting predicted the students' comprehension and interest. It is possible that engagement in selecting information via the use of annotation tools helps in organising one's comprehension of digital materials.

Annotation no. 2



Annotation no. 3

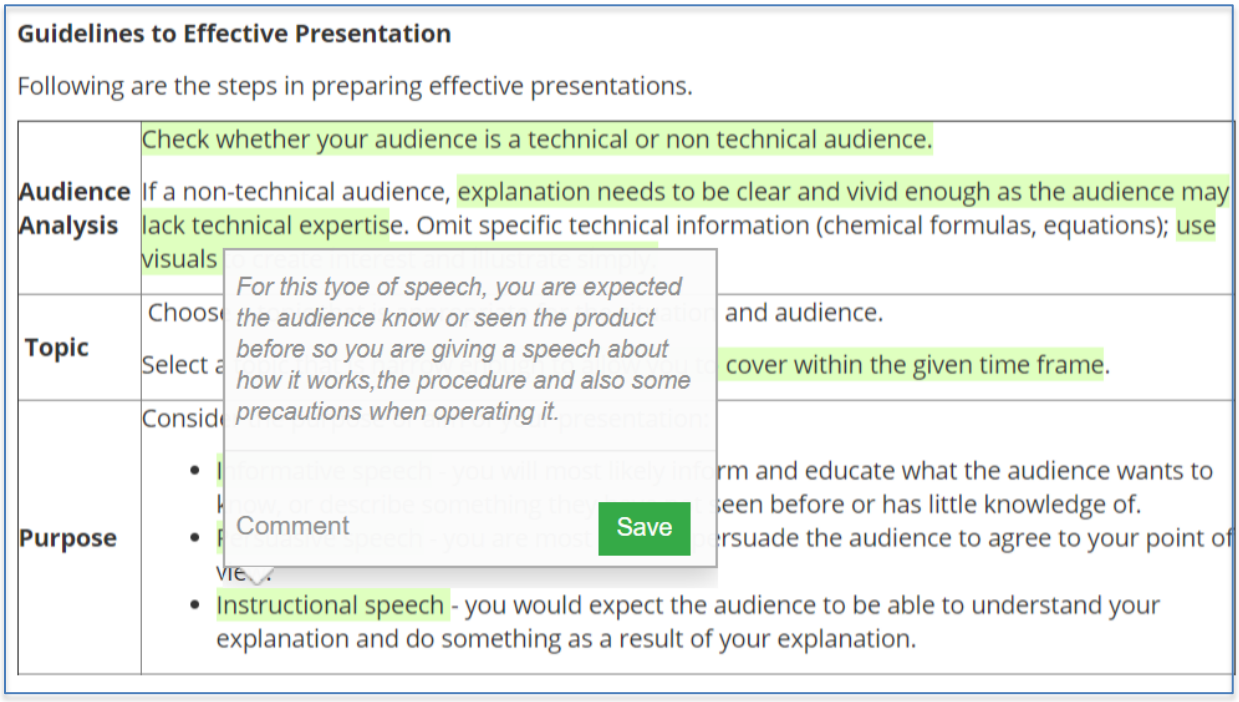
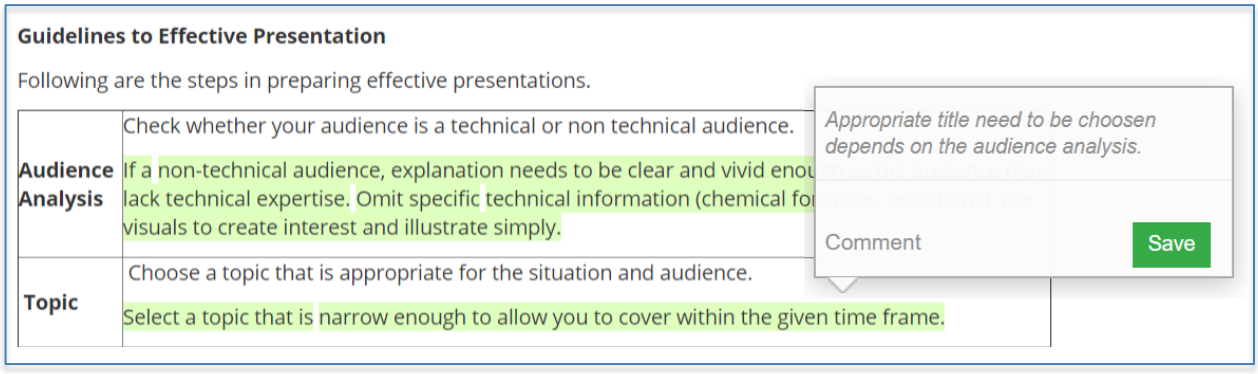


FIGURE 4. Screenshot of annotation no. 2 & 3 by Student E

Figure 4 illustrates annotations no 2 and 3, where Student E was able to elaborate the types of presentations by summarising and justifying ideas. This also showed that Student E was able to summarise the point by reiterating the meaning using his own ideas. This form of annotation plays a complementary role in the interactive reading model by Rumelhart (1977), which recognises the simultaneous interaction of lower-level processing skills and higher-level cognitive skills. Similarly, another annotation sample that depicts this ability is seen in Figure 5:

Annotation no. 4



Annotation no. 5

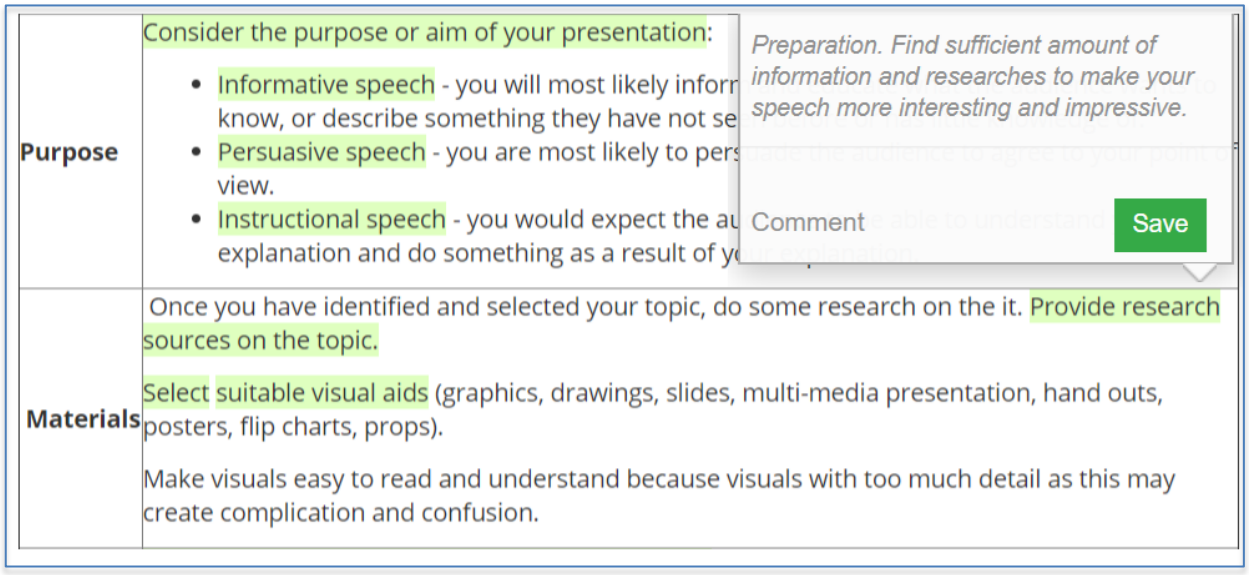
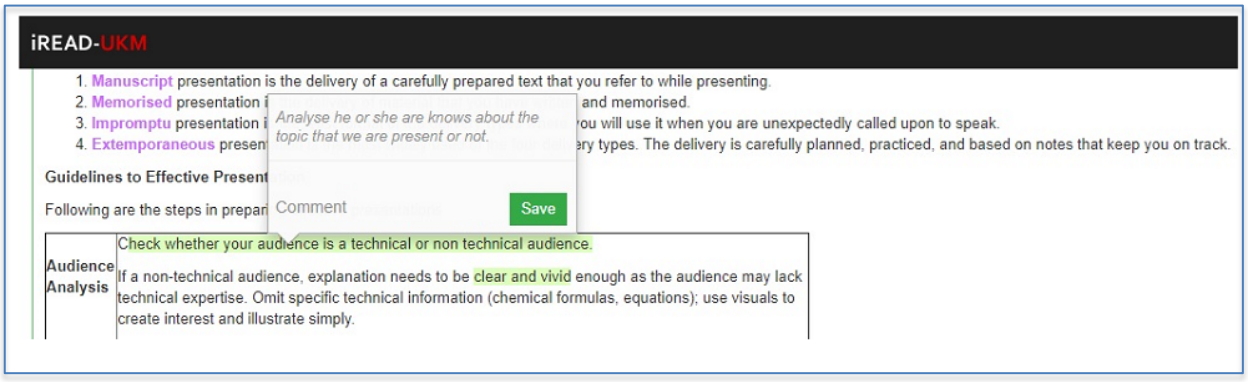


FIGURE 5. Screenshot of annotation no. 4 & 5 by Student G

Figure 5 illustrates two examples of annotations made by Student G. Student G was able to reproduce the meaning of the text by expanding the ideas that were highlighted. He stated the need to select suitable topics to relate to the audience. Student G also elaborated on the idea of preparing materials to make speeches more interesting and impressive. This clearly indicated that Student G was able to identify the main idea of the reading task as he admitted in Excerpt 2 interview: *"I refer back maybe I see the highlighted parts I know the main idea is there, so I know what the paragraph is about"*. This corresponds to findings from Tseng et al. (2015), in which readers who are actively thinking about what they read would add notes to reflect on their reading.

Annotation no. 6



Annotation no. 7

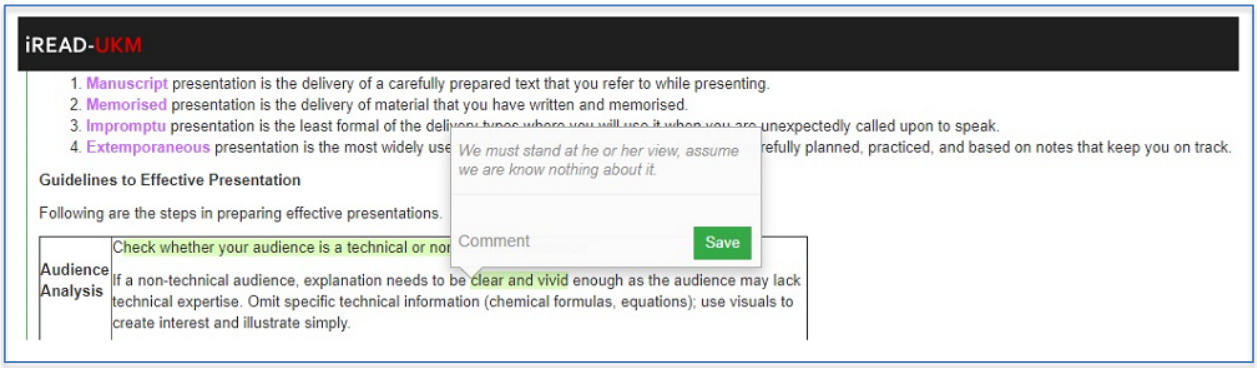


FIGURE 6. Screenshot of annotations no. 6 & 7 made by student J

The two annotations in Figure 6 showed that Student J was able to state his opinion about the first main idea on audience analysis. For example, in annotation no. 6, Student J stated that it is important to analyse the audience to see whether they know about the topic of the presentation. Although there were some grammatical errors, his annotation for the first highlighted idea showed that he understood the main idea. In annotation no. 7, Student J was able to summarise the main ideas about audience analysis by stating the importance of understanding point of view. He reiterated this by stating the need to assume that the audience may not know anything about the topic.

Annotation no 8

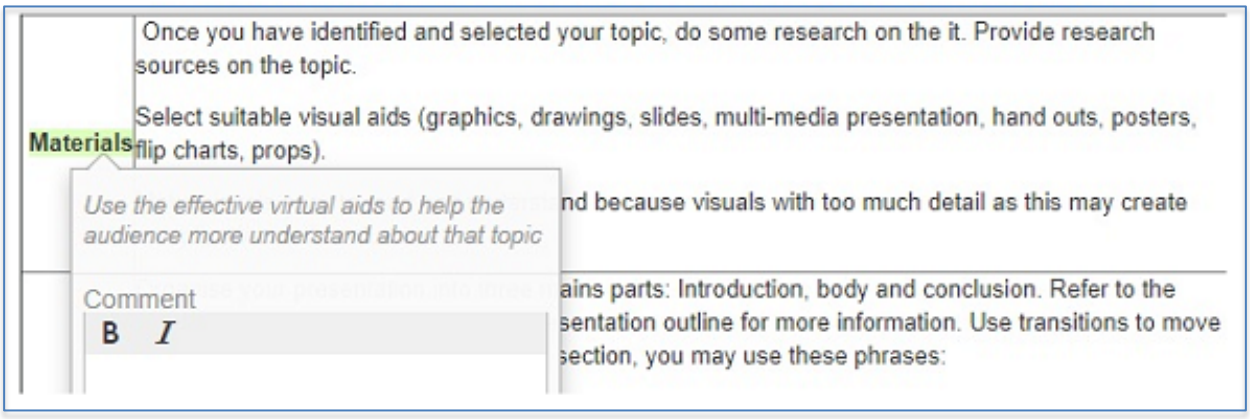
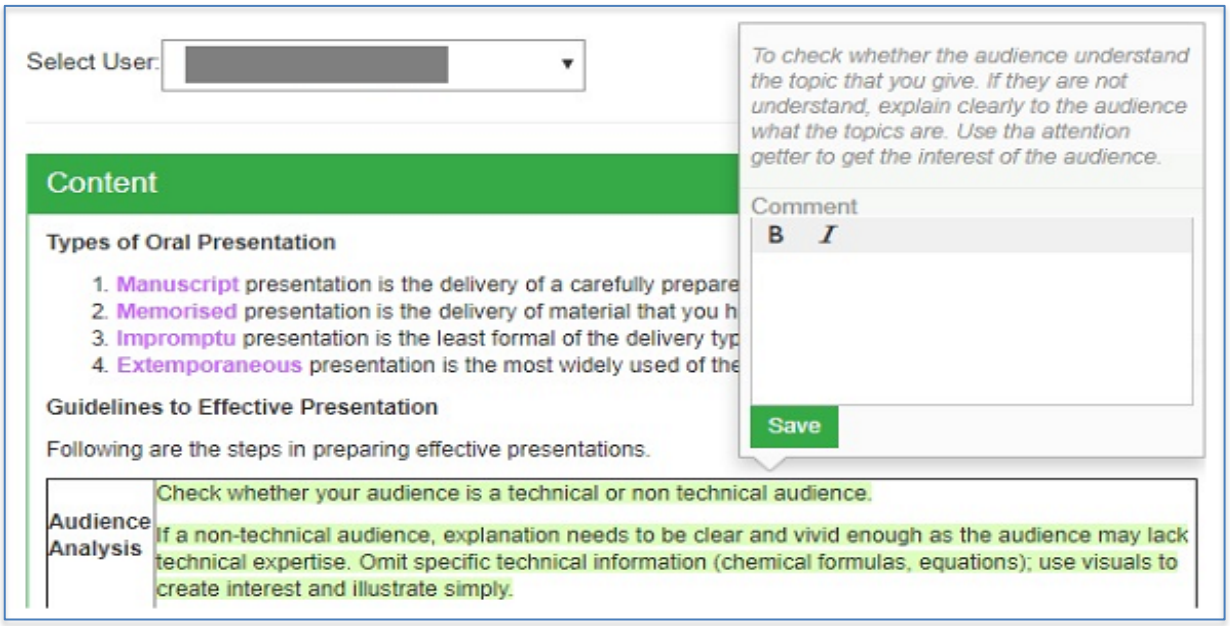


FIGURE 7. Screenshot of annotation no. 8 by Student A

As seen in Figure 7, annotation no 8, Student A justified the need to use effective visual aids in giving oral presentations. Even though he misspelled 'visual' which can denote a different meaning, Student A was able to identify the main ideas of the texts.

Annotation no 9



Annotation no 10

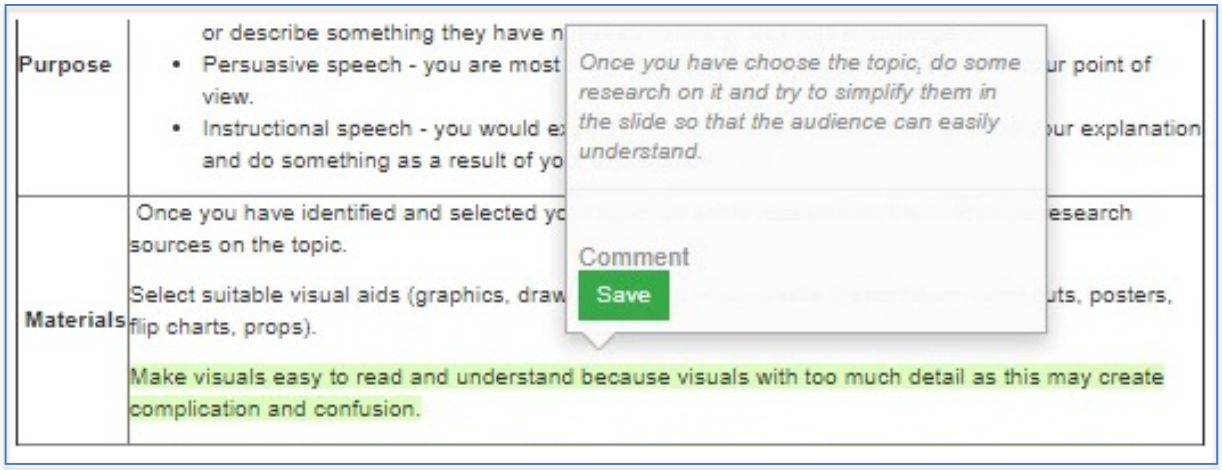


FIGURE 8. Screenshot of annotations no. 9 & 10 & by Student K

Figure 8 depicts two annotations made by Student K. In total, Student K was only able to annotate six parts of the reading text. All the annotations shared showed that he summarised the main ideas for each point but highlighted most of the text rather than just the keywords or main ideas of the text. For example, in annotation no 9, the idea of '*check whether…illustrate simple'* was highlighted entirely. This contradicts his claim in interview Excerpt 2 *"We can easily know the main point that we need to take out from the passage".* Student K failed to distinguish between highlighting the main ideas and supporting details of the paragraph, as claimed in the FGI. However, he was able to comprehend the online reading materials by summarising them. Essentially, the quality of highlighting contributes to the effectiveness of this technique in supporting greater learning from text (Winchell et al., 2020). To some extent, highlighting more may indicate that the learners are making less effort to engage with the text, as they are less likely to remember what is relevant (Dunlosky et al., 2013).

Annotation no 11

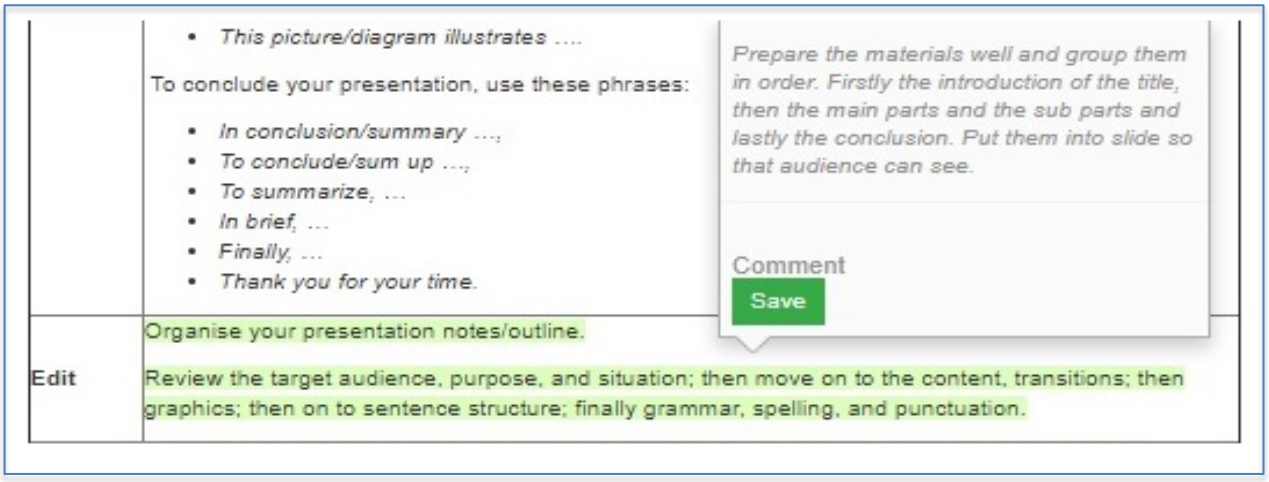
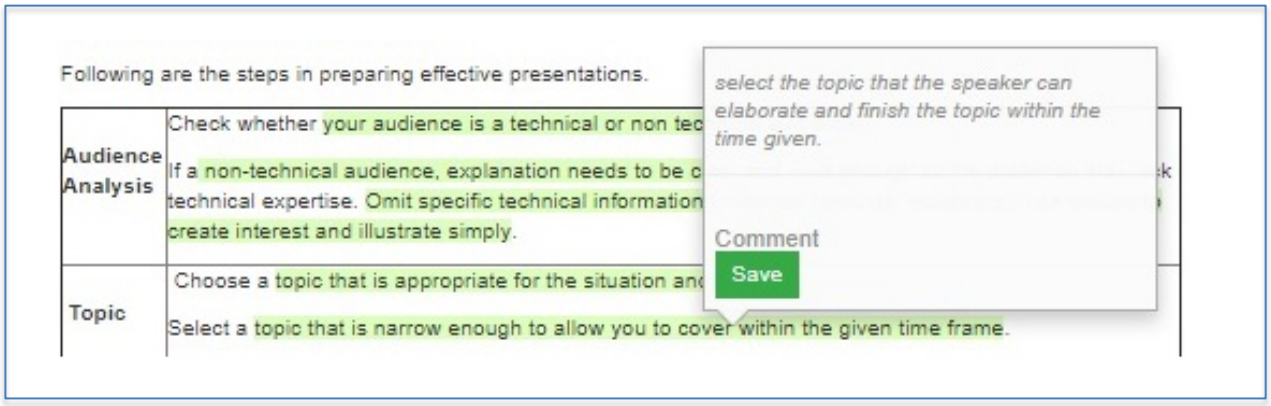


FIGURE 9. Screenshot of annotation no. 11 by Student R

Figure 9 illustrates Student R's ability to summarise the ideas in the online texts provided. This depicts an understanding of academic texts read online. However, Student R highlighted most parts of the text. This indicates that Student R was not able to highlight key points of the text. This can be an indication that Student R did not know how to identify the main idea or key points or failed to understand the instructions given.

Annotation no 12



Annotation no 13

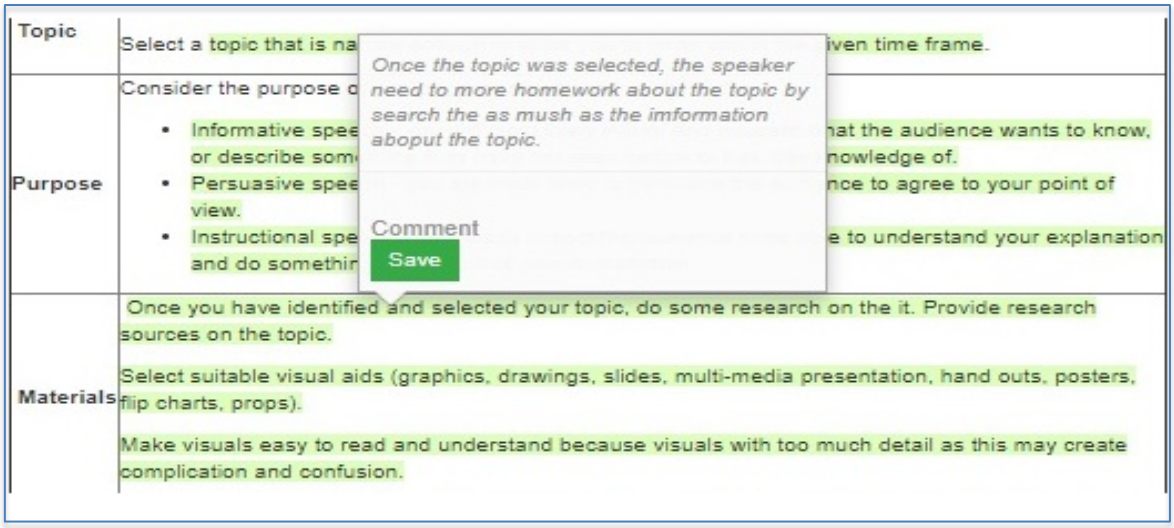
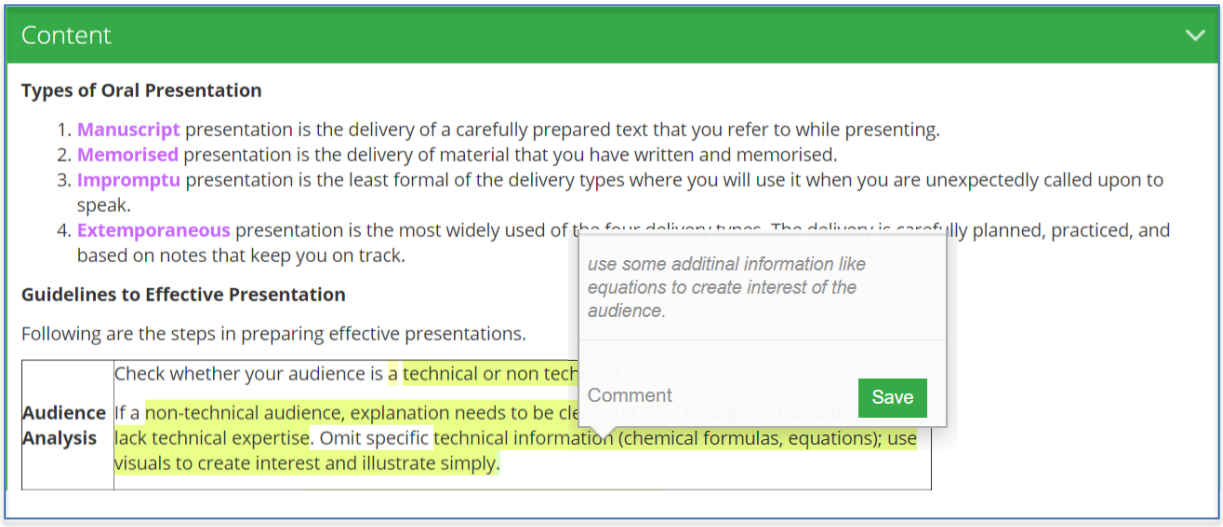


FIGURE 10. Screenshot of annotation no. 12 & 13 by Student T

Figure 10 reflects Student T's ability to interpret the meaning of the text by reproducing the main ideas. However, he lacks the ability to utilise the annotation function to highlight the main ideas. Student T highlighted most of the text, not just the keywords or main ideas. This implies that he did not understand the highlighting instruction. In contrast to what he admitted in Excerpt 1, *"iREAD can add in and highlight the main points or key words…It can help me to find the main idea and supporting details very fast".* Instead, whole chunks of text were highlighted.

This implied that Student T was not able to identify the main idea or keywords. However, Student T was able to rephrase parts of the texts.

Annotation no 14



Annotation no 15

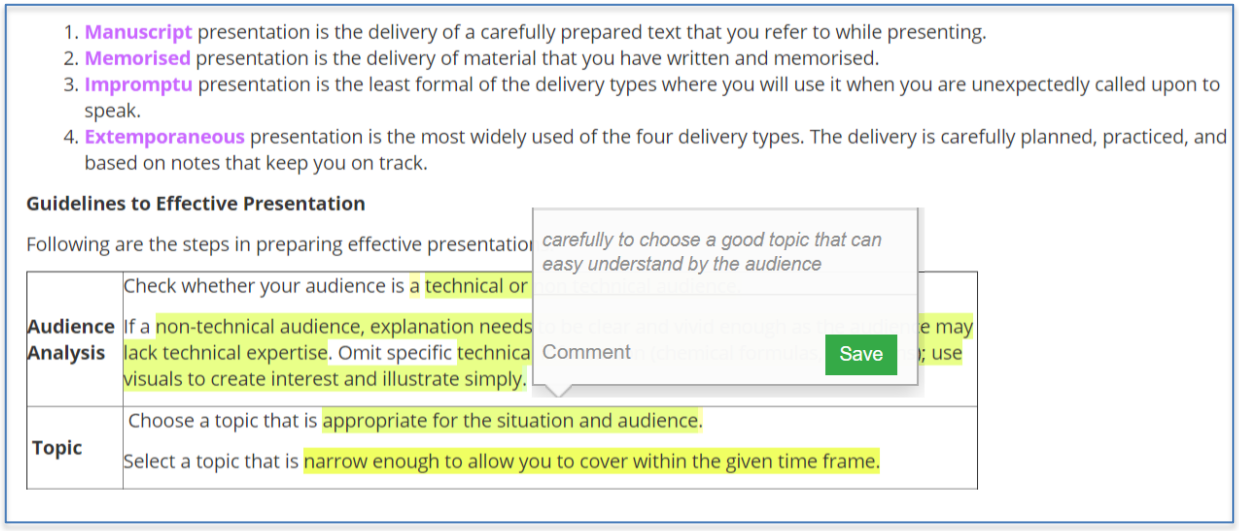


FIGURE 11 Screenshot of annotation no. 14 & 15 by Student C

Figure 11 illustrates two annotations made by Student C. Annotations 14 and 15 showed that Student C was able to identify and rephrase the main ideas. The written annotation that he made showed that it involves a deeper cognitive process, which included rewriting the main idea rather than merely highlighting the text. This indicated that students comprehended the text through a top-down process and interaction with the texts, which are considered complementary to the Interactive Reading Model by Rumelhart (1977). This suggests that interaction with online texts engages learners in learning. Although Student C made some grammatical errors, it did not

impede the meaning of the text. Key elements of interactive reading are also visible as students have proven to identify parts of the paragraphs.

Based on the FGIs, only seven students (students E, T, L, G, K, C, and I) reported that they were able to identify main ideas or keywords in online materials, but overall, the results in annotation analyses indicated that nine students (student L, E, G, J, A, K, R, T, and C) were able to reproduce the main ideas and summarise key points. Only 3 students failed to complete the tasks. These findings suggest that the use of annotations is effective in enhancing students' knowledge of main ideas. The data reported here appear to support the assumption that annotation tools facilitate the acquisition of language gains through identifying and reproducing main ideas. For example, Tseng et al. (2015) investigated the various annotations made by students who used *Annotate* and found that one of the major gains was annotations that were text-based annotations (identifying the main ideas of the texts). This finding was consistent with the current study.

In another example, Abuseileek (2012) reported the positive effects of using online annotations in learning. He reported that students who read materials using online annotations performed better than students who did not. However, it is interesting to note that although students were able to summarise ideas, reproduce main ideas and add new information, there were several instances where students highlighted entire parts of the reading materials. This can mean two things: either students did not understand the instructions or were not able to identify key points. It would be interesting to find this out further in follow-up interviews after data analysis for future research.

CONCLUSION

The main objective of this study was to explore the significance of DAT in helping students read EST online materials. The results of this study reveal that DATs have been shown to assist reading comprehension among L2 learners by allowing the learners to highlight and annotate online reading materials. This is evident in the findings of this study, which revealed that lexical recognition and identification of relevant information were achieved when learners used highlighting features to identify information and added notes by summarising, justifying, reproducing, and rewriting ideas. These annotations reflect the cognitive learning processes involved in learners' comprehension of information.

In an online reading environment, learners connect prior knowledge through visual representations created with annotations. This supports the Interactive Reading Model (Rumelhart, 1977), where learners engage with the text by identifying parts of a paragraph. The ability to contextualise and synthesise ideas enables learners to comprehend syntactic and discourse features that are commonly used in both EST and non-EST academic materials. Furthermore, highlighting allowed learners to be more engaged in reading while making annotations. This is an important factor when dealing with English at a more advanced level, such as those learnt in universities.

The multitude of functions of digital annotation tools support online reading, knowledge construction in reading, and foster comprehension. DAT also offers insights into the processes involved in reading by L2 learners and how they construct an understanding of the text. By examining the process that occurs while reading is taking place, reading strategies can be leveraged and further improved. However, it is important to note that more research is needed to fully understand the impact of online reading on language learning and to determine the best practices for implementation in a Malaysian context among university students. Future research is needed to identify text types for academic purposes in universities because learners may differ in

annotation types depending on the nature of the study. Nevertheless, the result of this study suggests that utilising digital annotation tools for online reading is a promising approach to improving reading among Malaysian university students.

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