

# i-ELLS: A Research-based design for an online interactive literacy system

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**Abstract**— There are only a few learning systems that take into account learner's needs and strategies. The interactive English Language Literacy System (i-ELLS) is designed from the ground up based on identified reading strategies of L2 learners at tertiary level. A survey was carried out to identify reading strategies used by these learners when they read in online environments. The findings provide the basis for the design of the system. This paper reports on how the strategies were mapped into technological features or tools within the system.

**Keywords**— digital literacy tools, interactive literacy, online reading, reading strategies.

## I. INTRODUCTION

READING should be viewed as an interactive process that involves the reader and the reading material in building meaning. Often, however, it is not. Students at tertiary level need to read a lot and if their reading ability is beyond the ability of an average reader, this can impede their academic progress. The explosive growth of online technologies and their adoption into almost every aspect of human activities means that online reading is becoming an important skill for L2 readers around the world. It is a fact that online reading serves as the source of input for thousands of L2 readers [1].

Clearly, reading in print and on the Internet are different. This implies that there is the increased need to train tertiary students especially how to read online because "electronic texts introduce new supports as well as new challenges that can have a great impact on an individual's ability to comprehend what he or she reads" [2]. With the availability of digital information and the increasing amount of time spent reading electronic media, it is relevant to explore and understand the shift in reading behaviour, i.e. from printed material to digital media. It has been observed that people prefer to print out electronic documents for reading than reading from screens, more so if the documents are long [3]. In fact, people are better at organizing and manipulating paper documents. On paper, text has a predetermined beginning,

middle and end, where readers focus for a sustained period on one author's vision. On the Internet, readers can surf through cyberspace at will and, in effect, compose their own beginnings, middles and ends. This requires that a different set of skills are required to manipulate electronic documents.

The introduction of new technologies such as hand-held devices like tablet computers and the more recent Apple's iPad opens up new possibilities for technology-assisted reading. When it comes to instructions, most research is still focused on how to use the internet to assist with reading instruction. The less explored area in relation to the previous focus is on how to shape or design web-based technologies to support reading. This paper discusses the implementation and initial testing for a platform designed to support reading that is designed with a view to actively support learner reading strategies.

## II. LITERATURE REVIEW

The technologies and tools related to online reading can generally be grouped into two categories: cognitive enabling technologies and collaborative enabling technologies. This view is close to the view of interactions as defined by Gilbert and Moore [4]: content and social interactions. Cognitive enabling technologies include tools used by the individual to help process, organize and manage his or her interactions with the digital texts; and examples include annotation tools, digital notebooks and dictionaries. The collaborative enabling technologies work beyond the individual to create and facilitate discussions and interactions with others within the context of the reading materials. This review will present literature on both types of technologies.

It has been reported that reading on traditional forms of paper is superior to reading on the computer] as it "supports extended, focused deep reading practices better." [5] (p. 217). Shilit et al introduces a device called XLibris that essentially allow users of the device to actively interact with electronic texts using a stylus pen. This '*digital library information appliance*' (p. 218) aims to make reading of electronic texts as natural as reading on traditional paper. Although it shows promise and great sophistication, it has not moved into mass consumer markets. More importantly though, XLibris in a way signifies the quest that is the focus of the cognitive enabling technologies i.e. allowing users or readers to interact with electronic texts as closely as possible to human-paper interactions. Shilit et al stated three reading activities that XLibris tries to support: reading (tangibility, page orientation

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and fixed layout), free form annotations and document fluidity.

In general, the use of annotation tools in whatever forms they take has been found to be positive for the readers and learners [6].

Hwang et al reported on the use of an annotation system for web-based texts on the premise that a web-based annotation tool may help with online learning [7]. The results of their study indicates that the annotation system, called VPen, help in improving students' performance. Melenhorst conducted a study comparing annotation tools and concluded that the in-text annotation tools are preferred by readers as opposed to external annotation tools that require a separate window or screen [8].

He further says that "...in designing annotation tools the use of the features should be immediately clear to the users as well as how the new features relate to practices in the paper world. Thus, learnability is the key usability principle."(p. 544). This means that online annotation tools should not impose a radically different schema on users when compared to traditional paper annotations.

Another tool within the category of cognitive-enabling technologies is the online notebook. It is not restricted to studies on online reading only as the value of such a tool within the larger context of online learning has been well established [9]. Watts claimed that online notebooks are a significant feature of the e-learning projects he studied due to its ability to promote 'reflection' [10]. Sadik describes online notebooks as important for learners to keep track of their learning and knowledge construction while stating that such a tool is often difficult to build [11].

Van Oostendorp reported no significant advantage to computer-based note-taking compared to traditional means of note-taking for reading comprehension. However, he also claimed that results for computer note-taking is promising as users are generally unfamiliar with the tools used [12]. Northrup reported that Intrapersonal/Metacognitive interactions (including note-taking) is rated highly by online learners. This suggests that an efficient method for online learners or readers to take note is an important part of the online learning or reading experience [13].

Technology-supported collaborative learning activities have been found to be beneficial in a number of studies as reported by Lehtinen et al. [14]. This is also supported by Roberts who said that "...the benefits of collaborative learning are widely known but rarely practiced, particularly at the university level." (p. vii) and "...the field (of collaborative learning) is not devoid of systematic empirical investigation." [15].

Mukkonen et al listed academic literacy as an important component in 'metaskills' (higher-level skills manifested through sustained efforts at knowledge creation) that may be developed through the use of collaborative technologies [16]. The most common form of collaborative technology is the threaded discussion forum or web forum. Weasanforth et al provides a detailed and well supported treatment on the use

threaded discussion boards for language learning:

"...The additional processing time provided through the asynchronous medium is particularly important when dealing with non-native speakers (Kamhi-Stein 2000a; O'Malley 1995). It promotes careful deliberation over course content, which in turn encourages critical thinking as students develop knowledge at their own pace (Jonassen 1994; Kamhi-Stein 2000b; Scarce 1997). Merron(1998) found that students using threaded discussions wrote more thoughtfully than students who were not afforded such opportunities. Similarly, Parker (1999) and Irvine (2000) found significant improvement in students' metacognitive reflection and depth of thought with the use of threaded discussions. Chong (1998) reports that students became actively engaged in course materials which provided opportunities to test understanding of the materials. The interactive and collaborative nature of asynchronous technology allows students to share perspectives and experiences, to establish relationships, to seek assistance (Chong 1998), to exchange information that can influence intercultural attitudes (Müller-Hartmann 2000), and to support and encourage each other (Collins & Berge 1996; Kamhi-Stein 2000b; Sengupta 2001). Further, it "allows everyone to be heard" (Greenlaw & DeLoach in press), including students who do not normally participate in faceto-face discussions (Kamhi-Stein 2000b; Schallert et al. 1998)...".[17]

Weasanforth et al also argues that the use of threaded discussion forums open up new learning possibilities that may not be available in a face-to-face environment. However, they also caution that such a use must be well integrated into the learning process to achieve any benefits for learners. In a review of related literature on web forums, it has also been suggested that the use of epistemological tools (sentence openers, graphic organizers, workflow templates and annotation tools) would be effective to better structure online forums [9]. This section has discussed the two categories of technologies commonly associated with improving online reading and literacy. The two categories are cognitive-enabling and collaborative-enabling technologies and a review of related literature has been presented for each.

### III. METHODOLOGY

This section describes the background to the study, the research method and instrumentation employed.

#### A. The Study

This paper reports on the development of a research-based online interactive literacy system that takes into account learner's needs and strategies, and significant skills and experiences associated with technology enhanced reading processes. Basic to the development is the identification of the different categories of reading strategies and reading style preferences of tertiary students when they do online and offline reading of academic texts. The findings inform and provide the basis for the design of the online interactive English Language literacy system.

The development of an online reading environment as conceived by i-ELLS departs from the conventional online reading courseware commercially available, in that the former takes cognizance of the use of reading strategies by the non-native reader when engaging in the academic reading process while ensuring compatible computer technological tools are used to enhance and to facilitate the reading process, content uptake and build a greater collective body of knowledge.

In essence, i-ELLS emphasizes on situated content and learning-in-context, with academic material that is 'chunked' and/or modularized and linked to appropriate online resources, reinforcing cognitive mapping and knowledge generation.

#### *B. Research Method and Instrumentation*

The study employed the survey method to gather data on reading strategies and online reading preferences. Survey is chosen over other techniques as the study aimed to collect data from a large population and employing other techniques such as interviews (which would have yielded a richer set of data) would be logistically impractical.

The survey was conducted on 320 respondents comprising first year from the Faculty of Social Sciences and Humanities at the Universiti Kebangsaan Malaysia. They enrolled in English for Social Sciences course, which is a compulsory English course for all first year students of the Faculty. The course aims to equip students with the relevant skills in English to enable them to cope with the demands of their academic environment. An integrated approach is adopted, incorporating the skills of reading, speaking and writing within the context of a particular academic area. The students are exposed to a variety of texts related to their disciplines. The subjects are heterogeneous in terms of their level of English language proficiency distribution. This varied distribution will provide a wider spectrum of reading strategies used by non-native readers of differing proficiencies.

The survey instrument used is a 45-item questionnaire designed to investigate the online reading strategies that are applied in a computer-based learning environment. The items were constructed based on the reading process framework that has been well established which categorizes reading strategies as cognitive, metacognitive and support strategies: Metacognitive strategies are those intentional, carefully planned techniques by which learners monitor or manage their reading [18]. Such strategies include having a purpose in mind, previewing the text as to its length and organizations, or using typographical aids and tables and figures; Cognitive strategies are the actions and procedures readers use while working directly with the text – understanding textual information. For example adjusting speed of reading, guessing the meaning of unknown words, re-read for understanding; Support strategies are basically support mechanisms intended to aid the reader in comprehending the text such as dictionary, taking notes, or underlining or highlighting the text for better understanding.

The questionnaires were distributed to the respondents through their instructors and were given a week to complete

and return them. The returned questionnaires were then analyzed using descriptive statistics [19]. The software package SPSS was used to assist the process and also for data display. The form of descriptive statistics that are used for data analysis is primarily frequency analysis. The analysis also made use of graphical procedures for data visualizations like pie charts and bar charts.

The results from the analysis are used to determine the most critical strategies that should be mapped into the technological features or tools within the system of an online reading platform. The following section describes the findings in detail.

#### IV. FINDINGS

The findings of the survey revealed that several types of strategies such as cognitive and metacognitive strategies were employed when reading online [20]. Generally, the survey showed that 84.4% of the respondents find the experience of reading online purposeful especially when they are able to distinguish the appropriateness of the content towards the purpose of their reading. Additionally, the readers recognized the need for them to critically analyze and evaluate the content before they could continue reading. Other significant findings highlighted specifically the meta-cognitive, cognitive and support strategies that the respondents preferred to employ when reading in an online environment. These include having a forum and chatting with other readers to discuss the texts; reading aloud the text to improve pronunciation and to enhance understanding of the texts; taking down notes about the reading content to help construct their own understanding of the text; and using vocabulary help to extract meaning from the rhetoric of the text. Based on these initial findings, the research team has mapped relevant web-based tools to the various strategies identified.

The first of these is the web forums to enable discussion and collaboration among users. Q1 (Table 1) shows 71.9% of the respondents agree that peer discussions is a strategy that is helpful to them. Only 27.6% respondents disagree that discussing with peers help then in understanding texts online (figure 1). The results indicate that learners agree that web forum allows them to discuss and exchange ideas, and to construct understanding of the texts. The forum as a form of avenue for online discussion also enables learners to build a social reading community online. The value of the web forums as a tool for collaboration in educational settings have been well established in the literature [9].

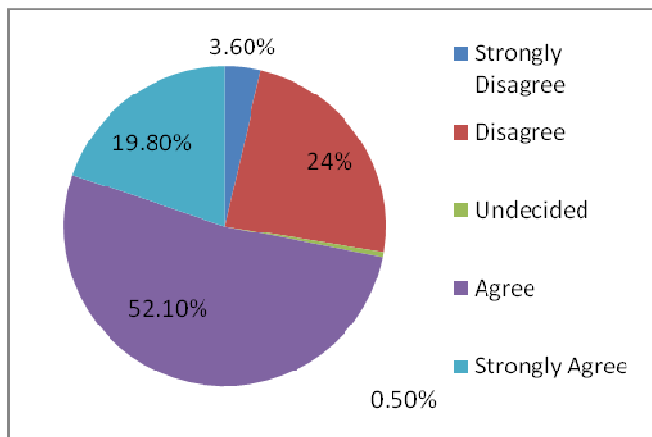


Fig 1: Result for web forums as a discussion tool

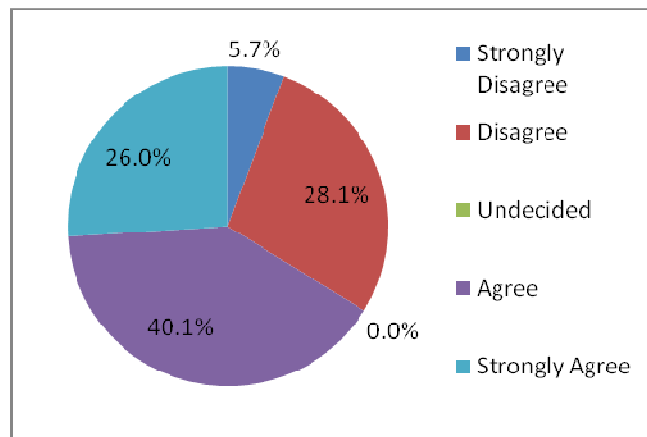


Fig 2: Result for using mark-up

In a review of related literature, it has been suggested that the use of epistemological tools (sentence openers, graphic organizers, workflow templates and annotation tools) to better structure online forums [9]. Therefore, online Annotation tools for example allow users to create annotations such as note-taking. The effectiveness of note-taking as a strategy is well documented for the purpose of reading.

Furthermore, Annotations provide several advantages to the user/reader. The first is that the reader will be able to ‘mark-up’ a reading text to match his or her internal schema for the understanding of the text. This is a cognitive strategy that will also help the reader to manage the cognitive load associated with reading a new material. The result shows that 66.1% of the respondents do some form of mark-up (highlight, underline, annotate) information within the text that can help them understand the text better. Only 28.1% respondents stated that they did not do any form of mark-up when they read (figure 2). Learners underlined important points, and asked questions while reading, which are considered as support reading strategies. The sentences or words are underlined because learners have problem understanding them, or they are important and meaningful points. Therefore, markings made on the text while reading help them to understand, remember, and give them more information because annotation occur within the context of the document [5]. This means that it is essential to provide Annotation tools to help readers process information and enhance understanding in a systematic way when they read online materials. Furthermore, this reading strategy makes the reading process more active rather than a passive process [20].

The second advantage of annotation tool is the ability to assist the reader in carrying out reflective activities while reading, by allowing the reader to insert prompts and questions within the text itself. Majority of the respondents, 74.5%, agreed that this feature is helpful (Figure 3). They mentioned that they use tables, diagrams and pictures within the text in order to understand better. Therefore, within an online reading environment, such tools allow students to carry out self-regulatory activities in order to improve reading comprehension. It is only logical that an online platform to help with literacy include a discussion forum for user collaboration. At the most basic level for i-ELLS, the annotation tools should allow for textual annotations to be inserted within preset locations in the reading texts.

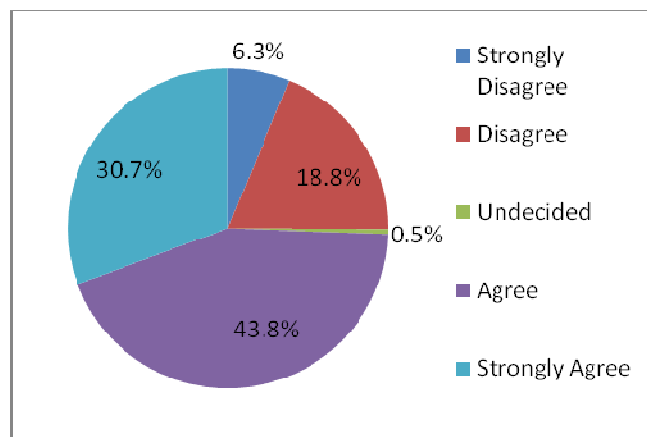


Fig 3: Result for using tables, diagrams and pictures

Considering this need the i-ELLS platform creates an environment where the artifact (reading material) is integrated with the discussion component. The advantages claimed are that the discussions are more contextualized; therefore the overall coherence of the discourse related to the artefact is improved. Besides that, there is the obvious benefit of convergence where discussions related to the reading material

are collected in one place.

In Q2 (table 1), respondents gave their views on note-taking as a strategy and 75% of them agree or strongly agree with the strategy (figure 4). This is a useful and common reading strategy used by readers when they read online texts or printed texts. Note-taking strategy helps readers to remember and understand texts better because when they write notes about the text that they are reading, their eyes captured what they have written and transferred it to the brain.

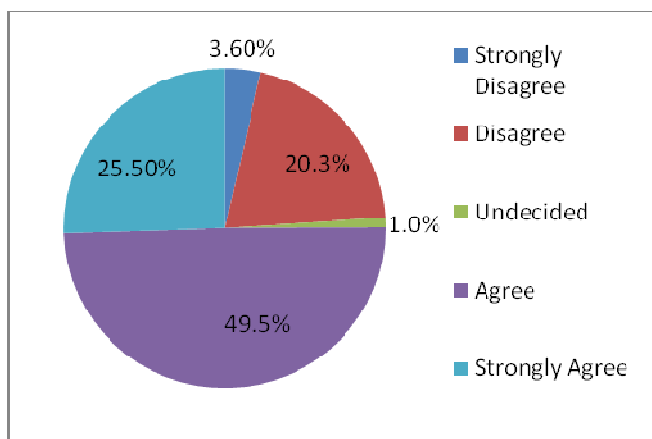


Fig 4: Result for note-taking

An Intrapersonal/Meta-cognitive interaction such as note-taking is normally given priority by student respondents [13]. This means that the design specifications for online literacy platforms should include facilities to enable meta-cognitive interactions.

Personal knowledge construction tool designed for i-ELLS would allow users to make personal notes about the reading materials and choose to share all or portions of their notes with other readers. These notes could contain hyperlinks and other forms of rich media such as audio recordings. In order to make the notebook more collaborative, users should be able to share portions of their own notes with other users. Alternatively, the readers can also audio/video tape their views of the text in place of writing notes.

Other design considerations based on the analysis of strategies include the use of digital audio to simulate read-aloud technique preferred by 66.1% (figure 5) of the respondents. The read-aloud technique, according to the respondents helped them to understand the text better and also helped them to improve their pronunciation. This cognitive strategy is essentially transformed technologically into the 'authoring' component in the literacy learning system. This feature is also able to attach an audio file to a text segment that is later presented together to the user/reader.

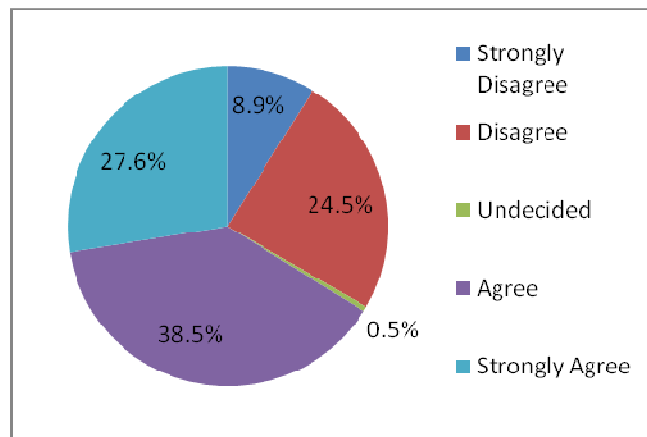


Fig 5: Result for using audio tool

The use of dictionaries also seems to be a support strategy preferred by the majority of the respondents (88%) (Figure 6). The respondents are English As a Second Language (ESL) learners, and hence, dictionary is an important tool to help them find meaning of words that they do not understand. The results revealed that most learners needed to refer to the dictionary because their vocabulary is very limited. Their reading process is usually interrupted as they stop to search for the meaning of particular words using hard copy dictionary. This means online reading materials should be supported by an integrated dictionary in order to reflect this support strategy. In addition, the integration of web based dictionary will help learners search for meaning from the text easily without having to stop and open a dictionary.

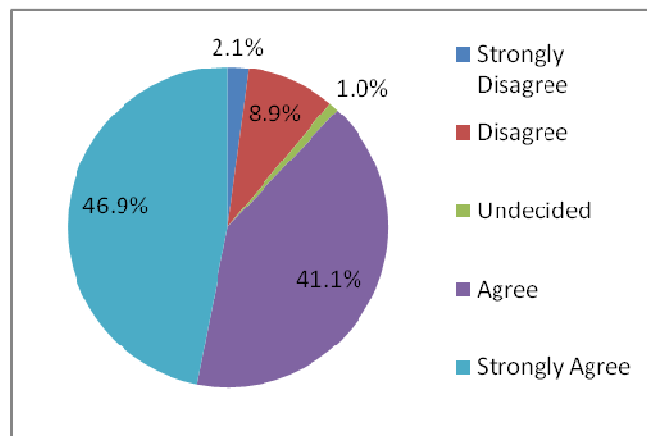


Fig 6: Result for using dictionary

Access to dictionaries during reading is a contributing factor to better retention and general ability to understand a particular text. A reader would need a certain level of grammatical and lexical competency to even begin the process of effective reading. Without a dictionary, effective reading might not be achievable for most low-level non-native learners of English. The approach taken by the i-ELLS platform is to connect to an online dictionary service that allows a user to access the

dictionary simply by double-clicking on any word within the reading panel as illustrated in the screenshot below:

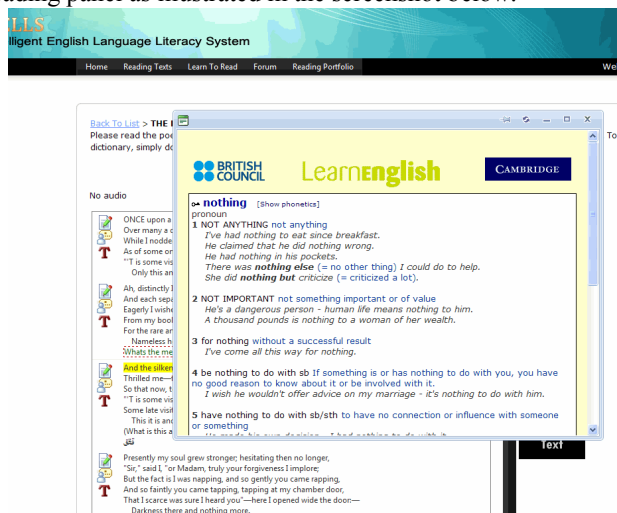


Fig 7

Table 1 summarizes the design specifications for an online reading system that are mapped to selected reading strategies significantly identified in the research

TABLE 1

Question	Design Specifications
Q1. In order to better understand a text, I discuss with other students.	Online discussion and collaboration tools
Q2. In order to better understand a text, I take notes.	Online note taking facility integrated into the platform
Q3. I skim through a text before reading in detail.	Platform should allow easy navigation of reading materials via scrolling etc.
Q4. When reading difficult texts, I read aloud to help me understand better.	Integration of digital audio in the authoring component.
Q5. I read carefully and deliberately in order to better understand a text.	Platform should allow easy navigation of reading materials via scrolling etc. Navigation should not be a cognitive burden to users.
Q6. I mark up (highlight, underline, annotate) information within the text that can help me understand the text.	Integrated annotation tools with features such as highlighting and underlining.
Q7. I refer to dictionaries to help me understand the text.	Integrated access to online dictionaries.
Q8. I use tables, diagrams and pictures within the text to help me understand better.	The online authoring tool used to create the reading materials should include the ability to insert graphics and pictures into the materials.
Q9. I use contextual clues to better understand a text.	The authoring tool should be flexible enough to allow authors to add or modify the texts to include contextual clues as needed.
Q10. I use formatting features such as boldfaces and italics to identify important information.	The authoring tools should have sufficient formatting options to allow authors to include boldfaces and italics when authoring the materials.
Q11. I ask myself questions as a technique to understand a text.	Online voice recording to allow multimodal 'note-taking'.
Q12. I refer to titles and headings to guess the contents of a text.	Authoring tool should be able to cater to formatting of texts to create headings and subheadings.
Q13. I sketch out diagrams or maps to help me understand a text.	Free-form annotations to create diagrams and maps are considered an advanced feature.

## V. DISCUSSION

Reading in a digital environment should be more than just a one-way interaction between the readers and the text. The research presented in this paper looks at possible interactions from two possible angles: cognitive/meta-cognitive/supportive and the collaborative aspects of academic literacy.

The importance of collaborative learning cannot be understated [21], [22]. The findings of the research seem to support this, and are similar to other studies on collaborative learning. The considerations for collaborative learning are reflected in the design of the i-ELLS prototype where there are two levels of collaborative avenues.

The first level of collaboration is available in the 'General Forums' section; and as the name suggests this is the place for

learners to discuss general topics. The second level is at the textual/material level where the artifact presented to the students carries its own section for discussion. This enables a more contextualized discussion to be carried and helps to concentrate knowledge at the most relevant and convenient location. This makes it easy for the next group of learners to look at topics and issues already discussed by the previous group and expand on the knowledge contained therein.

The research also covers the cognitive, metacognitive and supportive strategies of literacy in an online environment. The tools made available to learners within the system cater to the established cognitive activities involved in reading such as note-taking and highlighting. In fact, this is where i-ELLS differ most from other similar systems as learners are able to directly interact with the text i.e. online reading is no longer limited to static presentation of the text. The platform goes even further than just allowing textual interactions between the reader and the material. A feature available in i-ELLS, called the Video Journal, allows readers to create a collection of video journal entries related to the material directly from their webcams. This feature is built upon the recognition that learners could be multimodal i.e. they express themselves better in more than just one mode. The video journal allows readers who are more comfortable working with audio and video to easily and conveniently record their thoughts into the platform. It also adds the choice in what is known as ‘flexible learning’ for readers using i-ELLS [23]. The screenshot of the Video Journal is shown below:



Fig 8

The importance of cognitive and the meta-cognitive activities to learners are supported by many researches in the literature. The special features of the meta-cognitive, cognitive and support strategies are reflected in the design of the tools as can be seen in Figure 9 and Figure 10:

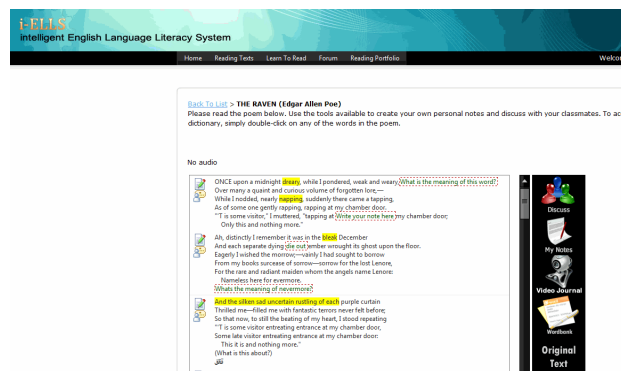


Figure 9

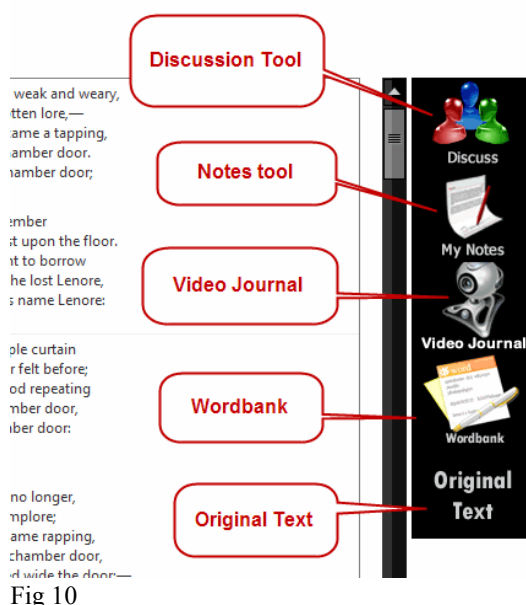


Fig 10

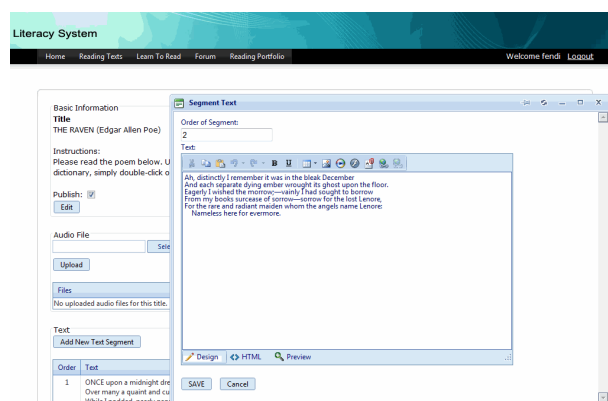


Fig 11

The research team also took into account the observations noted in Table 1 and incorporated most of them into the design of i-ELLS. For example, Q. 10 and Q. 12 in the table call for the authoring tool to be able to perform formatting functions that will support the related reader strategy. This is reflected in the system’s authoring module as shown by the figure 12 and 12A :

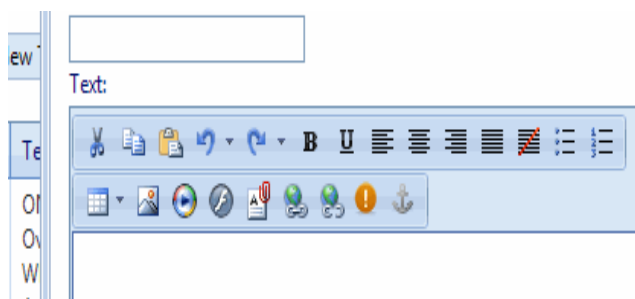


Fig 12

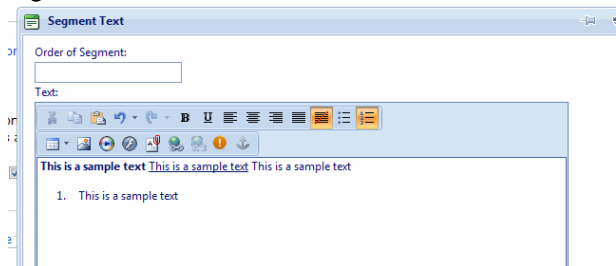


Fig 12A

The authoring tool is also designed to allow authors to insert images and multimedia elements into the reading materials. This is in direct response to Q.8 in Table 1 which states the need to support such feature as shown in Figure 13:

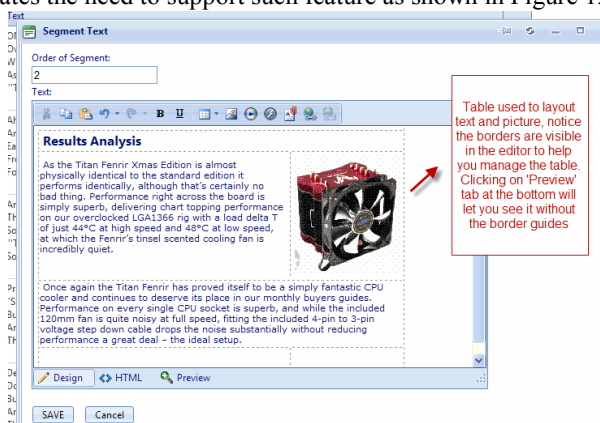


Fig 13

Another feature built into i-ELLS based on the findings of reader strategies is the inclusion of audio file for the reading text. Authors have the choice of including the audio version of the reading text by uploading the MP3 file into the system (Figure 14). Readers will then see the audio control and can choose to play the audio file of the reading text (Figure 14A).

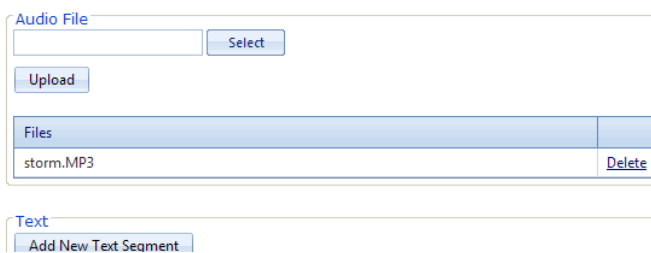


Fig 14

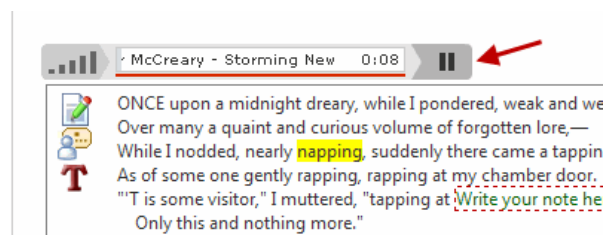


Fig 14A

## VI. CONCLUSION

This paper presents an interactive reading design based on the mapping of students' reading strategies to the technology needed to support the activities. The research team believes that it is important to design technologies to fit into what is known about reading strategies rather than arbitrarily designing an online platform without due consideration to the processes involved in reading. The i-ELLS is currently at prototype stage and is being readied for extensive testing in real use environments.

In its prototype state the system comprises of three components or modules: the reading module, the authoring module and a learner support module. The reading and authoring modules are interdependent, while the learner support module is a standalone component. Initial validation of the prototype is carried out via expert reviews and results seem to support the direction taken by the research.

Future developments of the system will include intelligent and improved collaboration features. The online reading system that is envisaged aims to empower students, rather than teach students through a traditional learning approach, which is merely based on knowledge transfer.

In conclusion this paper advocates the view that digital technologies employed in electronic texts can increase the array of learning opportunities for students as they embrace new ways of processing knowledge and construct knowledge in this digital age. Correspondingly this new learning environment requires a shift in learning approaches from information transmission to problem based learning, encourage active learning and critical thinking, and promote learning communities, lifelong learning, and incidental skills associated with learning and using technology, all of which the i-ELLS aims to achieve. Another step that would be beneficial is to conduct usefulness study that could accurately identify problems in terms of usability [24].

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