Effects of Free Learner Control with Quick Overviewing in Technology-mediate Learning

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Abstract
The degree of learner control is a crucial design element of flexible learning systems. An effective system must provide the capability for the learner to exercise control over the sequencing and pacing of the content. Quick overviewing is a form of scanning before reading. It improves reading comprehension of especially a large amount of information. A careful overview saves precious time and the ability to overview means students do not have to read everything when studying (Harvey, 1998). Although it has not generally been considered as a formal study phase, our study has revealed that it is an important factor in planning and organising a learning strategy.

This paper investigated the effects of quick overviewing and different control methods on learners’ performance. Learners for the research were divided into two groups: free-control group (FCG) and restricted-control group (RCG). The study results suggested that quick browsing together with free navigation control positively influenced the learning performance.

INTRODUCTION
Early technology-mediated learning systems were developed with the aim of emulating traditional learning environments or classrooms. The main disadvantage of these systems is that they perpetuate the problem, inherited from traditional face-to-face education, of addressing the needs of only a small subset of the population of learners. These systems can be classified as teacher-centred, mostly one-way communication and directed to linear and passive learners. Today, flexible learning has opened the door to a global classroom where learners are expected to be as different in learning styles as they are in numbers. The teacher no longer has total control of the learning environment. The control is now shared with the learner.

The issue of learner control, and most importantly, the degree of control that a learner can exercise over the learning environment, is crucial to the effectiveness of flexible learning systems. Current learning systems lack the flexibility to allow the learner to exercise this control. An effective system must provide the capability for the learner to exercise control. However, it cannot, at any stage, obligate the learner to use it. That is a choice that the learner must exercise.

Some form of e-learning is currently being used by most educational organisations ranging from primary to university level either as a standalone delivery method or as part of a blended delivery approach. The effectiveness of e-learning, and more recently m-Learning, in comparison to traditional face-to-face learning has been widely discussed in the literature. The results are not conclusive as the complexity of the learning differs from implementation to implementation due to the large number of variables involved in the learning process. The learning environment, the technology, the learners learning styles, preferences, motivation and attitude are just a few of these variables.

Quick overviewing is one of the activities generated from the learner control exercises. It is a form of scanning before reading details of information. A careful overview saves precious time and the ability to overview means students do not have to read everything when studying (Harvey, 1998).
This paper investigates the effects of the different learner control modes and browsing for less than a minute before learning. The effects will be measured and compared between the different control modes, based on the learners’ performance on online tests, final supervised test and a post-test.

2 EDUCATIONAL TECHNOLOGY
The introduction of technology-mediated learning has prompted a re-evaluation of learning strategies. Constructivism is gaining momentum and has been heralded as the most appropriate learning theory for the technological classroom (Spiro et al., 1988; Mann, 1994; Ewing et al., 1998).

Learner Control and Navigation Styles
Although current research acknowledges the potential benefits of giving learners a greater degree of control in the way they navigate the learning landscape, especially, in terms of pacing, sequencing and amount of materials used, there are still roadblocks that must be removed in order to ascertain its learning value (Perez and Jo, 2000). One of these roadblocks is the reduced feeling of ownership experienced by some learners. Scheiter and Gerjets (2007) suggest that there are four major factors involved in determining the effectiveness on learner control: usability, learner characteristics, lack of conceptual foundations, and methodological shortcomings of studies presented.

Navigation and Learning Styles
Learner-controlled learning sequence refers to the learners’ capacity and desire to select the order in which to work or study the learning materials provided by a technology-mediated learning system. Within this context, learning sequence can be considered to be equated with navigational patterns in learning. In order to be efficient, the system must provide well-structured and sequenced learning materials that are appropriate for both linear and nonlinear learners (Ivanoff and Clarke, 1996). Linear type learners seldom question the learning sequence provided; they progress through the material as it is presented. Some learners learn best when they exercise self-control over the learning environment, but this is not true of all learners (Snow, 1980; Friend and Cole, 1990). At times, however, the educator must constraint the environment. For example, if a unit contains health and safety instructions about working in a science laboratory this section of the unit must be completed before a student is allowed into a science lab, and therefore, the sequence cannot be altered for safety reasons.

Overviewing before Learning
Beginners often benefit from having a structured learning path (Eaton, 1996). However, nonlinear learners possess an innate need for exploring the material presented before settling down for a specific sequence (Kelley and Stack, 2000). Quick overvviewing is a form of scanning before reading and, especially with a large amount of information, improves reading comprehension. A careful overview saves precious time. The ability to overview means students do not have to read everything when learning (Harvey, 1998). It provides students with:

- understanding the amount and structure of information,
- noting important headings and subheadings,
- determining what to read and in what order,
- determining what to pay careful attention to,
- determining what to ignore,
- deciding to skip text because it contains no relevant information, and
- activating prior knowledge, deciding if the text is worth careful reading or can be skimmed instead.

Browsing through the e-learning space for short periods of time, for less than a minute, has been found to positively affect the learners’ performance. Browsing can occur at different stages during
the leaning, Fiorina (2004); (Calcaterra et al., 2004) suggests that browsing in the early stages to
gather an overview of the content and revisiting sections promotes knowledge acquisition. This is
also supported by research by (Gilbert et al., 2007). Their study found that most learners’ technique
is to skim through information to gather an overall understanding and then continue with the task or
skip it. The technique can not only be interpreted as an online browsing strategy but also as a time
management strategy used to organise the learning. Fiorina (2004) study also found that previous
computer skills of learners favoured the skimming or pre-viewing navigation preference than left-
right brain thinking styles. The influential factor in determining success was the initial skimming or
exploration of the content.

Most learners rarely read the pages online; they quickly scan for keywords. A study by Monk (2005)
found that about 50% of learners viewed three-quarters of more of the learning content for less
than 20 seconds per page and 40% of learners displayed this pattern for half to three-quarters of the
materials presented. A quarter of all users stayed on a page between 20 and 39 seconds. These
results were consistent across all demographic variables used in the study (such as course, age and
centre). An interesting finding was the fact that although 77% of learners printed the online material
their feedback denoted that they were satisfied and expressed a preference for online delivery.
(Monk, 2005)

3 Technology-Adaptive Learning (TAL) MODEL
The model is designed and implemented under a constructivist framework and includes learner
control capabilities. The implementation method selected is a technology-mediated system using an
Internet-based or intranet-based delivery platform that runs independently from the university main
server. It is supported by an Apache server and integrated with a database management system
(DBMS) using a MySQL server and PHP as the main scripting language.
Henceforth, the term constructivism is used in this context, and to this effect, the learning model
developed is based on the following principles:

- All learners are different
- Learning is individual to each learner
- A learner can learn at different speed levels in different situations
- Learners can control their learning sequence
- A learner can engage in different learning strategies simultaneously
- Learners learn best within a context
- Learners construct and reconstruct knowledge as they seek to understand and explain their
  environment

The concepts of learner individuality and learner control are essential to this study’s view of
constructivism (Perez and Jo, 2000). The main variables involved in the proposed model in relation
to learners control and learners’ choices and options are:

- Learning objectives
- Learning objectives within the model will be explicit, clearly specified and achievable.
- Amount of information provided and used
- Learning material appearance and mode
- Pacing and timing
- Sequencing
- Place and location
- Monitoring learners’ individual progress
- Interaction and collaboration
- Non-assessable Evaluation
The TAL model is composed of five modules: the Learner Module, the Educator Module, the Designer Module, the Cyber Classroom Module and the Analyser Module, Figure 1. The overall process involves the creation of the learning materials by the educational designer and, in the technical side, by the technology designer. The materials are then made available to the learners through the Cyber Classroom Module and the learners are supported by the educator or instructor. And finally, the learners’ performance and feedback are recorded into the Analyser Module for further analysis and evaluation.

Figure 1. TAL Model with its five modules: Learner Module, Educator Module, Designers Module, Cyber Classroom Module and Analyser Module.

There are some guidelines for the educational and technology designers, in order to maximise the effect of the TAL model.

3.1 Structure and Modularity Guidelines

The learning materials for adaptive e-learning must be structured as modularly self-contained units (Schlupe et al., 2005). These units should be built around a single core concept, which is presented in its basic form and developed to a more complex form. For example, adding, subtracting and multiplying can be taught as single or separate units and they can later be combined to teach division. In this case adding, subtracting and multiplying are the building blocks necessary to construct a new one and they must be learned before the learner can fully understand the concept of division. Adaptive e-learning materials must be structured in such a way that they provide flexibility and choice. However, sometimes the learner may be enforced or guided to do certain units if necessary. This will avoid disorientation, waste of time and effort (Mayer, 2003; Müller-Kalthoff and Möller 2003), or the learners being overwhelmed (Lowerison and Schmid, 2007). If a learner is already experienced with any of the units, after quick overviewing, he or she should be able to skip the current level and progress to the next one.

3.2 Navigation Guidelines

The TAL system includes a global graphical representation or map of the entire course. This type of map is helpful in guiding learners’ navigational or sequencing decisions (Barba, 1993). Research carried out by Chou and Lin (1998) suggests that the type of map used is important and can have a significant effect on search efficiency. In general, Chou and Lin report that global maps are preferred
to local maps. In another study, Pohl, et al. (2003) also reported that global maps are used very often and play a significant role in learners' navigational choices. In technology-mediated environments, the notion that learning outcomes may be affected by individual differences and individual navigational behaviour is an important one to consider. (Gaus and Urban, 2003; Magoulas et al., 2003)

3.3 Control Mechanism and Assessment Guidelines
Traditionally, assessment has been used as a tool to test whether or not learning has occurred. This type of approach presents assessment items as mere measuring instruments to ascertain to which degree learning conforms to the expected outcomes. Used in this way, it is a passive device with no learning capabilities. However, it can be transformed into a learning tool if its outcome is presented, not as a final ruling, but as a progress indicator or a guiding control mechanism. Designing effective and efficient assessment is a challenge. Educators plan teaching and learning activities to match assessment requirements. However, learners use an opposing view and look at assessment requirements to plan their learning strategy (CSHE and AUTC, 2002).

The TAL model includes non-assessable evaluation, in the form of feedback quizzes, to ensure that the learner obtains appropriate feedback on the learning process, not just a judgment of their performance. Feedback quizzes provide both a means of testing, and a means of monitoring the progress and identifying revision needs. A feedback quiz is prepared to output the correct answer and feedback, indicating which area needs to be revised, the corresponding learning objective involved and a link to the section covering the required material. These quizzes can be placed in every unit or activity at specific checkpoints to help learners make decisions about their own learning strategies. Quiz results and number of attempts can be recorded into the database to generate a learner profile, which can be used to provide further feedback based on progress. In addition to the quizzes, online tests are included in every unit. Test results are also recorded into the database. The online-tests of every unit of the TAL system are intended as a self-assessment tool. These will provide an indication of the learners’ progress through the unit and their level of preparedness for the external examination. Completion of these online tests is recommended but not compulsory in the TAL model.

3.4 Learner Controlled Variables Guidelines
The learner control variables have been built into the model structure and they are: learning objectives, amount of information provided, monitoring of learners individual progress and assessment are controlled by the instructor. The amount of information used/added/removed, material appearance and mode, pace, timing, sequencing, place and location are potentially controlled by the learners. Learners must be made aware of the existence of these variables and the potential control that they can exercise. The learners must also aware that it is their choice to use the control variables, but not an obligation. Joung (2004) states that learning is a dynamic process and that the locus of control is also dynamic and adjusts itself according to the situation. Learner control over the learning environment must be exercised to improve learner performance and satisfaction. It is expected to be a flexible process between learner and educator. Either party can initiate dialogue or collaboration as the need arises.

4 IMPLEMENTATION
The experimental students chosen for this research were attending a university level course of six weeks duration. The sample group was divided into two sub-groups, with demographically comparable characteristics. Data collected from this study falls into two major categories, electronic and paper-based data. The study uses an explorative research approach that presents results using a combination of quantitative and qualitative data analysis. The quantitative data analysis is based on the performance results of the treatment group, FCG, and the control group, RCG and on the post-
delivery survey. The analysis tool used is t-Test to find the inferences about the difference between two population means for small and independent samples having unequal standard deviations.

Overall, the performance of the FCG was slightly better than that of the RCG. The RCG achieved 74.83% average mark in the final exam and 29.17% in the post-exam test. Three students declined to take part in the post-exam test. The FCG achieved an average of 81% in the final exam and 50.96% in the post-exam test with two students declining to take the post-exam test, Figure 2. Besides the very top and bottom marks, FCG shows slightly better performance overall.

The results from the post-exam test, which represents the ability of knowledge retention, shows a bigger difference between the two groups than the final exam results in Figure 2. While 75% of the RCG obtained less than 40 marks, 70% of FCG obtained over 40 marks, Figure 3.

An analysis of their navigation history reveals that the RCG learners navigated the learning materials in a predominantly forward linear fashion. With the exception of the first two weeks, the typical navigation pattern of FCG learners was very similar; they also followed forward navigation and the sequencing as presented. In the first two weeks they browsed, overviewed, the overall units several times. It indicates that they did this to gain an insight into the content of the units and what was expected to learn during the course. The tracker recorded these pages as browsing (less than one minute). There are more obvious differences between the two groups during the early weeks. It is presumed that students freely overviewed all the teaching materials and improved their motivation and understanding.
The weekly navigation patterns are significant, especially in regard to the FCG. Linear navigation was expected from the RCG as they could only navigate from the current unit backwards. This navigation mode can be considered to be good for revision but not as a learning strategy in the explorative sense. The weekly patterns differentiated the two groups learning strategies and provided some substantiation to the proposition that individuals can use learner control to customise their learning environment.

The average time per session is 36 minutes for the RCG and 38 minutes for the FCG. This is congruent with Monk’s (2005) study where 80% spent less than one hour a week online and about two-thirds spent less than 30 minutes. An overview of the navigation patterns of the two groups reveals that the RCG visited 32% less pages than the FCG, spent 22% less hours on line and undertook 9% less sessions on line. Figure 5 shows a summary of navigation by both groups.

<table>
<thead>
<tr>
<th>TOTALS</th>
<th>FCG</th>
<th>RCG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours on line</td>
<td>136.15</td>
<td>106.42</td>
</tr>
<tr>
<td>Sessions</td>
<td>183</td>
<td>166</td>
</tr>
<tr>
<td>Pages visited &gt; 1 minute</td>
<td>1767</td>
<td>1203</td>
</tr>
<tr>
<td>Pages visited &lt; 1 minute</td>
<td>1106</td>
<td>391</td>
</tr>
</tbody>
</table>

Closer scrutiny of the tracker stored data revealed that 62.5 % of all pages, which was visited by the FCG, were in the category of browsing for less than one minute while for the RCG was just 32.5%. The tracker system also showed that the amount of printing done by the learners was considerable: 47% of the RCG and 27% of the FCG. This has decreased the transparency of their navigational patterns.

5 CONCLUSION

This paper has presented a technology-mediated learning system, the TAL model based on constructivism that offers learner control capabilities. Several design guidelines were proposed to the educational and technology designers. The TAL model was implemented for teaching a university course. The research has investigated how different learner control modes and quick overviewing affected the learning pattern and performance of learners. The sample group was divided into two groups: FCG and RCG, based on different degree of leaner control. Some of the findings of this research include the below:

- The FCG students achieved slightly better results from the final examination.
- The FCG students retained the knowledge longer than RCG.
- Quick overviewing, browsing less than one minute per page, was significantly observed among the FCG students over the other group. They visited more sessions but spent less time to complete the course. They also achieved much higher marks than the RCG students.
In conclusion, a high degree of learner control encouraged students’ quick overviewing and produced a more effective learning performance, and a more efficient time management strategy.

6 REFERENCES


