Chapter 19

ASSESSING THE EFFECTIVENESS OF A BLENDED WEB-BASED LEARNING ENVIRONMENT IN AN AUSTRALIAN HIGH SCHOOL

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The enhanced accessibility, affordability and capability of the Internet has created enormous possibilities in terms of designing, developing and implementing innovative teaching methods in the classroom. As existing pedagogies are revamped and new ones are added, there is a need to assess the effectiveness of these approaches from students' perspective. For more than 30 years, proven qualitative and quantitative research methods associated with learning environments research have yielded productive results for educators. While much of the research has focussed on characterising the learning environment, fewer investigations have used the results as a tool to refine the learning environment. This chapter presents the findings of a study in which *Getsmart,* a teacher designed website, was blended into science and physics lessons at an Australian high school. It shows how the results of learning environments research were used in assessing the effectiveness of the approach from the students' perspective. The investigation also gave an indication of how effective *Getsmart* was as a teaching model in such environments.

1. Introduction

Goodrum, Hackling and Rennie's (2001) report titled *The status and quality of teaching and learning of science in Australian schools* pointed out that on average, the actual picture of science was "disappointing" and the quality of teaching ranged from “brilliant to appalling” (p. 85). As a result of this grim picture, enrolments in science have probably diminished significantly and according to Harrison (as cited in Roberts, 2002, p. 13) science “was in danger of becoming an optional snack in a smorgasbord of subjects”.

The report *Australia's teachers: Australia's future* (2003) argued for an immediate need to improve “scientific and mathematical education and technological capability” (p. 1). It also emphasised the need for ongoing innovation as a prerequisite for “future growth and prosperity in a competitive global economy” (p. 1). Apart from giving science, technology and mathematics a high national priority in education, the report also suggested the need for high levels of research and development. The report also highlighted the decline in the number of students who completed year 12 physics, chemistry and biology as a national concern.

In order to reinvigorate student interest, is blending technologies in science a feasible option? Cooke (2005) pointed out that all innovative approaches, no matter how simple or complex should be designed with the students in mind. Students’ perspective on such innovations was a critical issue. For many high school students, systematic integration of web-based applications into teaching routines is still in its infancy. New initiatives can be sustained provided there are appropriate research and development mechanisms in place to evaluate them. By applying some of the research techniques associated with learning environments, the success of such innovative practises can be adequately ascertained.

2. Learning Environments

Research has shown that the learning environment is an alterable educational variable which can directly influence cognitive and affective outcomes (Wang, Haertel, & Walberg, 1993; Waxman & Huang, 1998). It is not the only variable which affects learning outcomes; nonetheless, it is a very important one. By using various reliable instruments and a variety of qualitative methods, researchers have been able to assess the perceptions of educators and learners of their learning environments. This has enabled them to “theorise teaching and learning from different vantage points” (Tobin, 1998, p. 223).

A learner is constantly interacting with his or her learning environment. In 1935, Lewin proposed the Lewinian formula, $B = f(P,E)$.

This formula hypothesizes that human behaviour (B) is a function of the personal characteristics of an individual (P) and his or her environment (E) (Fraser, 1998). This hypothesis has since generated considerable interest and formed the basis for further research in various situations where human behaviour is demonstrated. Since an individual is always interacting with his or her environment, observed behaviour is a result of the combined effect of the interaction between variables P and E.

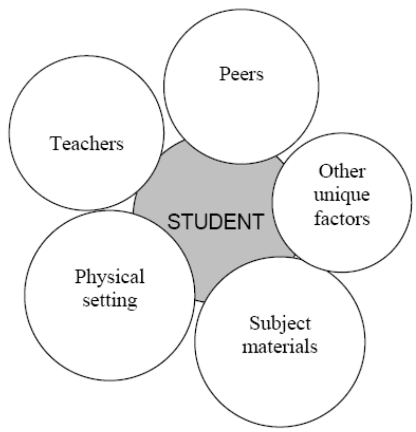

Figure 19.1. Variables in a student's learning environment.

In an educational setting, a learner is constantly interacting with an array of variables, such as teachers, peers, physical settings, subject materials and a cluster of factors unique to different learners (Figure 19.1). For this reason, there was a need to develop suitable learning environment instruments that had the capability of quantitatively measuring the impact of the learning environment on a learner in different settings. These economical, reliable and valid learning environment instruments enabled researchers to assess classroom environments from a student's perspective (Henderson & Fisher, 1998).

The foundations for this now flourishing field of learning environments was initially laid by two psychologists who were working independently of each other. The work of Walberg (1976) and Moos (1974) led to the development of a variety of learning environment instruments. Despite the development of several learning environment instruments over the years, the design is essentially the same. Learning environment instruments have scales and within each scale is a series of items, which help formulate student perceptions for that scale. The construct validity of each scale is determined by gathering qualitative data from the respondents.

3. The Web-based Learning Environment Instrument (WEBLEI)

The *Web-based Learning Environment Instrument* (WEBLEI) (Chang & Fisher, 1998, 2003) was used to gather data quantitatively on students' perceptions of their web-based learning environment in a tertiary environment. In the design of the WEBLEI, Chang and Fisher (1998) created four scales and the first three were adapted from Tobin's (1998) work on *Connecting Communities of Learning* (CCL). The CCL was developed by Tobin to study the perceptions of maths and science education students enrolled in an asynchronous mode.

The WEBLEI measures students' perceptions across four scales – Access, Interaction, Response, and Results. According to Chang and Fisher (1998), for students to use this medium, they have to successfully access the Internet. Consequently, the Access scale establishes the extent to which variables associated with accessing this medium meet students' expectations. Once the students have logged in successfully, they should be able to interact productively with their peers and their teachers. Hence, the Interaction scale explores the extent to which this is achieved from students' point of view. The Response scale gives an indication of how they felt about using a web-based medium and the Results scale gives an idea of whether they accomplished any of the learning objectives by using the learning resources accessed through this medium.

The purpose of the research described in this chapter was to assess the effectiveness of an innovative website as a teaching model in a blended learning environment by using the WEBLEI and other qualitative methods. These results would then be used in the further refinement of *Getsmart* and the teaching approach used in the study.

4. The Modified Version of the WEBLEI

In this study, the WEBLEI was modified and used for quantitative measurements. The initial version of the WEBLEI was designed by Chang and Fisher (1998, 2003) to quantify students' perceptions of their learning environment in a higher-learning institution where the entire course was offered online. In this research, the course was offered in a blended environment to students in a high school. While in a university environment, courses are generally delivered through sophisticated software (e.g., *WebCT*), in this instance, the course was delivered by *Getsmart.* In this teacher-developed website, the learning activities were different. Therefore, most of the items in the WEBLEI were either amended or changed to suit this study. The modified version had a total of 32 items with eight items in each scale (Chandra, 2004). The total number of items and the number of items per scale were similar to those in the original version of the WEBLEI.

5. Design and Development of *Getsmart*

Liber (2005) argued that the design of e-learning environments should not be left to the technicians and programmers. There is a need for teachers to become more proactive in driving the technology. Through such an approach, teachers have a far greater control in terms of how the learning activities are designed, developed and sequenced.

In this study, *Getsmart* was designed on the electronic cognitive apprenticeship teaching model (Collins, Brown, & Newman, 1989; Wang & Bonk, 2001) by a teacher with no formal training in the field of ICT's. Within this framework a variety of learning opportunities such as modelling, coaching, scaffolding, articulation, reflection, exploration, and questioning were created through web-based lessons, tests, online chats, and interactive activities (Chandra, 2004; Chandra & Fisher, 2004).

Brooks, Nolan, and Gallagher (2001) proposed numerous features that websites should have in order to improve learning outcomes. A high degree of interaction was one of their suggestions. Features which promoted interaction included provisions for asynchronous discussion (emails and bulletin boards) and synchronous discussion (chat rooms). They suggested that websites should use hypertext links to enable readers to make decisions about their reading, web-based assessment tools such as quizzes and tests, visual media such as still images and images in motion and a “neat” domain address to identify the website.

Janicki and Liegle (2001) developed WebTAS (*Web-Based Tutoring Authoring System*) which blended parts of instructional design theories and ideas proposed by web researchers. WebTAS incorporated features such as multiple examples and exercises, consistent layout design, feedback management, and tracking process capability.

Figure 19.2. Part of the content’s page of Getsmart.

The educational value of the website has to blend in with good web design principles. Issues such as the process, interface and site designs, page design, typography, editorial style, graphics, and multimedia were recognized as essential ingredients of a good website (www.webstyleguide.com). While all these ideas were acknowledged in the design of *Getsmart*, one of the key aspects which steered its development was the feedback gathered from the WEBLEI and qualitative data gathered through emails and written surveys.

The website had a neat domain address (u2cangetsmart.com). Students accessed the website via the *Splash Page*. Once their user name and password was validated, students were then able to access the *Contents Page.* A part of this page is shown in Figure 19.3.

Figure 19.3. Part of the lesson page on Inertia and Momentum.

The *Lesson Pages* were designed on single topics that focussed on a handful of concepts. Each page highlighted the key terms and formulae. Links were also provided to WebPages that that were either embedded in *Getsmart* or on other websites. Discussion questions and solutions to worked examples were also provided on most pages. Students also had the option to email queries. A part of the *Lesson Page* on Inertia and Momentum which was designed for year 10 science students is shown in Figure 19.3.

According to a recent report (Goodrum, Hackling, & Rennie, 2001), in Australian schools, the quality of formative assessment and teacher feedback on student progress varied. Only 7% of high school students were given a quiz to see how they were going in every lesson and 16% participated in formative tasks once a week It was also interesting to note that 23% of the student population had never seen such tests and almost one third had never received any feedback from their teachers on how they were going in science.

For the reasons highlighted above, an online test was linked to each lesson which gave students instant feedback. The results were written to a database against the user's name. Each test consisted of either ten multiple-choice or short answer questions. The feedback indicated the percentage correct but did not indicate the specific questions that were correct or incorrect. This was done on purpose to ensure that students revisited the questions and compared their answers with their colleagues and teachers. This created discussion opportunities. A part of the *Test Page* linked to the Reaction Time and Distance lesson (designed for year 10 science students) is shown in Figure 19.4.

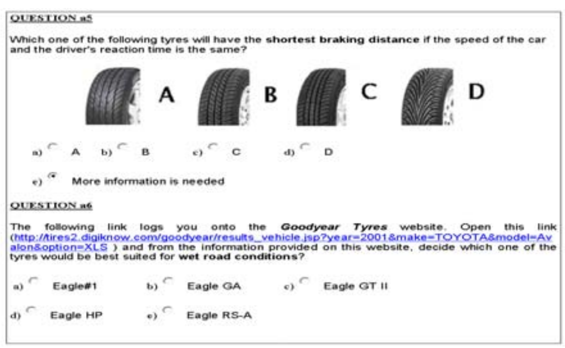

Figure 19.4. Part of the *Test Page* on Reaction Time and Distance.

6. Implementation of *Getsmart*

The website was aimed at students in years 10, 11, and 12 (ages 15-17 yrs.) studying junior science and physics. For this reason, ease of use was central to its development. The lessons were designed so that they would keep students on task and could be completed within a normal school period. Students accessed the website for one period each week and web-based lessons were designed for units of work that lasted for a term. Each school period lasted for a maximum of 31 minutes (it generally required three to five minutes for students to login into the school computers). Students could also access the website outside class times including their homes. A total of 261 students from 11 classes participated in the study.

7. Data Collection and Analysis

Once students had completed their unit of work in the blended mode, the WEBLEI and a written survey were administered. Data from the WEBLEI survey were coded and entered as 1 (Strongly Disagree), 2 (Disagree), 3 (Neither Agree nor Disagree), 4 (Agree), and 5 (Strongly Agree). Emails were received throughout the course. Not all students responded via emails or to written surveys.
Statistical measurements such as mean, median, standard deviation, alpha reliability, and discriminant validity were determined. All emails and answers to written questions were read and the key points were identified in each instance.

8. Results

8.1. Reliability and validity of the modified version of the WEBLEI

The reliability analysis gives an idea of the extent to which items in the same scale of a learning environment instrument are related to each other. The Cronbach alpha reliability coefficient measures the internal consistency and is based on the average inter-item correlation. All values above 0.60 obtained through this calculation are considered to be acceptable (Nunnally, 1967). In this study, the alpha reliability coefficient of the four scales of the WEBLEI ranged from 0.78 to 0.86 (Chandra, 2004). The discriminant validity determines the extent to which a scale measures an unique dimension not covered by other scales in the instrument. In this study, the discriminant validity (the mean correlation of one scale with each of the other scales) of the modified version of WEBLEI obtained ranged from 0.52 to 0.59 for the four scales (Chandra, 2004) indicating that each of the four scales measures distinct, though partly overlapping elements of the web-based environment.

8.2 WEBLEI Results

The mean obtained for each scale was very close to four for all scales (except for the Interaction scale where it was 3.53). For the Response and Results scales, the means were slightly higher than those reported by Chang and Fisher (2003). They reported means of 3.96 for the Access scale, 3.55 for the Interaction scale, 3.37 for the Response scale and 3.72 for Results scale. In this research, means of 3.94, 3.51, 3.74, and 3.88 were obtained for the Access, Interaction, Response, and Results scales respectively (see Table 19.1).

Table 19.1. Mean and Standard Deviations for the Four scales of the WEBLEI (Phase 1)

WEBLEI Scales	Descriptive Statistics		
	Mean	Standard Deviation	Valid Cases
Access	3.94	0.66	214
Interaction	3.51	0.77	213
Response	3.74	0.72	213
Results	3.88	0.68	214

A mean of 3.94 (SD = 0.66) for the Access scale suggested that students agreed that their learning environment was convenient and easily accessible at locations suitable to them. It enabled them to work at their own pace. A web-based environment also gave them greater autonomy in achieving their learning objectives. A further analysis of each of each items in this scale suggested relatively high agreement in each instance (Table 19.2).

Table 19.2. Means and Standard Deviations of Students Responses to the Items of the Access Scale

Item No.	Statement	Mean	Standard Deviation
1	I can access lessons on the Internet at times convenient to me.	4.08	0.94
2	Lessons on the Internet are available at locations suitable for me.	4.14	0.80
3	I can access lessons on the Internet on days when I am not in class or absent from school.	3.90	1.20
4	Lessons on the Internet allow me to work at my own pace to achieve learning objectives.	4.07	0.99
5	Lessons on the internet enable me to decide how much I want to learn in a given period.	3.83	1.07
6	Lessons on the Internet enable me to decide when I want to learn.	3.78	1.08
7	The flexibility of lessons on the Internet allows me to meet my learning goals.	3.79	0.96
8	The flexibility of the lessons on the Internet allows me to explore my own areas of interest.	3.93	1.01

N = 214

The Interaction scale produced a mean of 3.58 (SD = 0.71) (see Table 19.1), the lowest of all three scales. An average of three implied that students neither agreed nor disagreed with all the items in the scale. A mean of four suggested that they agreed with the statements. A mean of 3.58 suggests that there was agreement to a certain degree to the items of the Interaction scale. The means and standard deviations for each item of this scale also were analysed and are presented in Table 19.3.

From the means shown in Table 19.3, it is obvious that Items14 and 15 which were connected with enhanced verbal interactions with peers during Internet lessons received the highest rating. However, items (9, 11, 12, and 13) that were related to emails were the ones in which the students expressed the greatest uncertainty (Neither Agreed nor Disagreed). The results to these items could be interpreted as follows. Students had the option of asking teachers questions by sending an email (Item 11), however, they were not sure if they felt comfortable sending teachers emails (Item 12). For this reason, not all students sent emails (Item 9) and consequently, they did not receive a reply from their teachers (Item 13). However, of the 171 emails, received in the study, very few had specific questions that needed to be addressed. Most of them highlighted positive aspects of the blended approach to learning science and while all emails were acknowledged and responded to, it was the researcher who replied to them and not the teachers. This provides another explanation for the low mean obtained for Item 13.

Table 19.3. Means and Standard Deviations of Students Responses to the Items of the Interaction Scale

Item No.	Statement	Mean	Standard Deviation
9	I communicate with my teacher in this subject electronically via email.	3.41	1.29
10	In this learning environment, I have to be self-disciplined in order to learn.	3.40	1.20
11	I have the option to ask my teacher what I do not understand by sending an email.	3.61	1.27
12	I feel comfortable asking my teacher questions via an email.	3.31	1.34
13	The teacher responds to my emails.	3.10	1.23
14	I can ask other students what I do not understand during Internet lessons.	3.98	1.08
15	Other students respond positively to questions in relation to Internet lessons.	3.76	0.93
16	I was encouraged by the positive attitude of my friends towards the Internet lessons.	3.55	0.98

N = 213

A mean score of 3.74 (SD = 0.72) was obtained for the Response scale (see Table 19.1) which implied that students generally agreed web-based learning was satisfying and it enabled them to interact with other students and their teachers. They also enjoyed learning in this environment and they believed that this approach held their interest in the subject for the whole term. While the lowest rating item for the Response scale was Item 24 (I felt a sense of boredom in this subject towards end of this term.) with a mean of 3.05 (SD = 1.27), I enjoy learning in this environment rated the highest with a mean of 4.15 (SD = 0.92*)*. All other items generally demonstrated agreement to the items with means greater than 3.6 (Table 19.4).

Table 19.4. Means and Standard Deviations of Students Responses to the Items of the Response Scale

Item No.	Statement	Mean	Standard Deviation
17	This mode of learning enables me to interact with other students and my teacher.	3.60	1.11
18	I felt a sense of satisfaction and achievement about this learning environment.	3.62	1.03
19	I enjoy learning in this environment.	4.15	0.92
20	I could learn more in this environment.	3.93	1.08
21	I can easily get students to work with me on the Internet.	3.89	0.98
22	It is easy to work with other students and discuss the content of the lessons.	3.96	0.91
23	The web-based learning environment held my interest in this subject throughout this term.	3.74	1.13
24	I felt a sense of boredom in this subject towards end of this term.	3.05	1.29

N = 213

For the Results scale, Chang and Fisher (1998) reported a mean of 3.75. In this research, the mean score of 3.88 (SD = 0.68) (see Table 19.1) for this scale suggested that students agreed they could establish the purpose of web-based lessons. It was also easy to follow, well sequenced, and clear. The structure kept them focussed and it helped them learn better the work that was done in class. The content was presented well and it was appropriate for delivery in a web-based learning environment. The tests at the end of the lessons, improved their understanding in the subject. In the Results scale, individual items had means that ranged from 3.62 to 4.12. It was interesting to note that items 25, 26, 30, 31, and 32 had means greater than 3.88 (Table 19.5).

Table 19.5. Means and Standard Deviations of Students Responses to the Items of the Results Scale

Item No.	Statement	Mean	Standard Deviation
25	I can work out exactly what each lesson on the Internet is about.	3.88	0.92
26	The organisation of each lesson on the Internet is easy to follow.	4.13	0.83
27	The structure of the lessons on the Internet keeps me focused on what is to be learned	3.62	1.05
28	Internet lessons helped me better understand the work that was taught in class.	3.68	1.04
29	Lessons on the Internet are well sequenced.	3.78	0.92
30	The subject content is appropriate for delivery on the Internet.	3.90	0.91
31	The presentation of the subject content is clear.	4.01	0.84
32	The multiple choice test at the end of each lesson on the Internet improves my learning in this subject.	4.01	1.04

N = 214

9. Discussion and Conclusions

The data generated through the WEBLEI suggested that students had positive perceptions of their web-based learning environment. This was also confirmed by qualitative data gathered through student surveys and emails (see Chandra, 2004).

Results gathered across the four scales suggested that the integration web-based learning in science and physics lessons was convenient and accessible, promoted autonomy of learning and enabled students to work at their pace. It also promoted positive interactions between peers during Internet lessons, enhanced enjoyment and learning opportunities in the subject, and sustained interest in the subject. Lessons on *Getsmart* were clear, easy to follow and understand, and well sequenced. Online tests provided valuable feedback.

While the WEBLEI painted a positive picture of *Getsmart* as a teaching model in a blended environment, it also showed that emails as a vehicle for electronic interaction were not preferred to the extent to which they were initially intended. Students' qualitative responses provided additional evidence on this issue.

> *I agree that I can communicate via email but prefer to have my questions answered face to face.*

> *I didn't communicate via email because there might be a pause of one day before a response, in which case I would have already forgotten my problem.*

> *I don't like the email all that much and if I don't understand something, I'd rather talk to someone face to face.*

The WEBLEI was initially designed for students at universities in off-campus environments where the interaction between learners and educators via the Internet was essential. In a blended learning, high school environment, learners are probably looking for an interactive learning environment with technology. They are looking for an opportunity to be away from the classroom momentarily and from human beings. While emails are productive for the ideal student who reviews his or her work on a daily basis, identifies problems, and forwards queries electronically to his or her teacher, very few students probably fall in this category. High schools are probably still a few years away from producing a learning culture where learners have the confidence to conduct their learning in this manner. For many, asking the teacher questions face to face in class is probably viewed as a more feasible and preferred option.

The findings of this research also suggested that the items on the Interaction scale of the WEBLEI were inadequate in measuring the interaction between learners and technology. Students appear to have achieved more through their interaction with the technology itself by using applets, simulations, online tests, and online experiments. Qualitative data and teacher observations supported this view (Chandra, 2004). In the initial design of the WEBLEI, Chang and Fisher (1998) proposed the following connection between the scales:

Scale 1 (Access) → Scale 2 (Interaction) → Scale 3 (Response) → Scale 4 (Results)

In this study, it appears that the Interaction scale was not as significantly interconnected as the other three. When Chang and Fisher (2003) administered the WEBLEI to university students, they reported values of 3.96, 3.55, 3.37, and 3.72 for Access, Interaction, Response and Result scales, respectively. In their study, the Response scale was rated the lowest. In this study, the Interaction scale was rated the lowest. While the characteristics of the items in the Interaction scale are important qualities of online learning, in this case it appears that there was significant interaction between students and technology. It is probably this interaction (rather than interaction between learners and educators) which led to a significantly higher mean for the Results scale. Otherwise, given the rationale of the design of the WEBLEI, these results may not have been obtained. For this reason, another scale should most probably be added to the existing WEBLEI design with items that specifically measure the interaction of learners with technology in an online learning environment.

The learning environments research undertaken in this study has demonstrated the usefulness of *Getsmart* as a model for teaching science and physics in a blended environment. Additionally, the findings of the research have also produced areas within the model that need further development and refinement.

Acknowledgments

We thank the teachers of the high school in Queensland, Australia where this research was conducted. The first author of this paper is also grateful to Education Queensland for the award of the Premier's Smart State Teacher's Excellence Scholarship.

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