Chapter 4. Evaluating the Psychology Electronic Warehouse (PEW)

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Abstract

This paper reports the findings of a pilot study designed to investigate the usefulness of an evaluation paradigm for providing information that can be used to improve learning outcomes. Specifically, an interactive software package called the Psychology Electronic Warehouse (PEW) was evaluated to see how students worked with the software and what they learnt. Unlike previous evaluations of the PEW, this evaluation was the first to directly assess students' actual learning, as opposed to their perceptions of what they learnt from using the PEW.

1. The educational potential of internet-based interactive multimedia

Internet-based interactive multimedia provides a range of learning opportunities through an integrated mix of text, graphics, sound, animation, video, data, and other information supported by dynamic databases. The educational potential of such systems has been well documented (Bates, 1995; Brooks, 1997; Halal, 1994; Laurillard, 1993; T. C. Reeves, and Reeves, P.M., 1997). In these environments, different learning styles can be accommodated, a high level of flexibility is enabled, and students can be actively engaged in learning and reflection on learning.

Over the past few years, a number of commercial software packages have been developed to assist students' learning of statistics. Similarly, interactive CD-ROMs have been developed commercially to accompany psychology textbooks. (e.g Mind Matters can be used in conjunction with several texts.). Because of the plethora of quality commercial products for psychology students, very few interactive multimedia developments have occurred within universities to address particular educational problems. StatPlay is one exception. It is a collection of microworlds, games and simulations developed at The University of Melbourne to improve students' understandings of statistical concepts (Cumming, 1995). Gazzard and Dalziel (1997) report on a web-based interactive tutorial for psychology students developed to engage students in more active learning. ASCILITE proceedings (1997, 1998, 1999, 2000) contain numerous papers about the use of web-based, interactive multimedia for teaching difficult concepts in various other discipline areas. At the Australian Psychological Society's annual conference in 2000 a range of papers reporting on the use of IT in the teaching of psychology were delivered. These papers covered areas such as the use of interactive CDROMS to teach psychological concepts such as basic visual neurophysiology and using the internet to enhance teaching and professional collaboration. Similar innovations have been reported at conferences in the United Kingdom (e.g. CiP2000 http://cti-psy.york.ac.uk/cip2000/Programme/programme.html; ICCPL http://www.strath.ac.uk/conferences/iccpl/ICCPL.html). However, the PEW is the first comprehensive package that uses the range of internet-based technologies in an integrated way to assist students' understanding of the whole research process as it applies in the discipline of psychology.

2. The evaluation model

The evaluation model underpinning this study is the Eclectic-Mixed Methods-Pragmatic Paradigm described by Reeves (1997). It has also been referred to as the Multiple-Methods model. This model is a pragmatic mix of both quantitative and qualitative methods for gathering data. As with the qualitative, interpretive paradigm described by Patton

(1990), it recognises the complexity of educational situations as well as the chaotic and unpredictable nature of phenomena in educational settings. At the same time, it recognizes the legitimacy of implementing quantitative methods to enable generalisations from the data (Gay, 1987). Triangulation of data is a characteristic of the model that enables reasonable cross-validation of findings relating to particular variables. The disadvantages of one method can be offset by the advantages of another.

3. What is the Psychology Electronic Warehouse?

The PEW is an innovative and exciting educational software package that consists of twenty online workshops, each addressing a theoretical issue presented as a research problem. The learning framework is provided by a seven-stage model of the research process (see Figure 4.1). A significant strength of the PEW is that it integrates relevant information technologies: interactive multimedia (IMM), Computer Assisted Learning (CAL), Computer Managed Learning (CML), and Computer Mediated Communication (CMC). The PEW exploits the potential functionality of these technologies to realise learning outcomes, which could not have been achieved in any other way.

Through the PEW, students are guided in the exploration of various theoretical issues drawn from specific content areas within the discipline of psychology. Working at their own pace and level of understanding, students can:

- participate in real-time experiments and contribute results to the student data pool;
- receive an immediate summary and analysis of these results that is responsive to the input of every individual student;
- access online resources such as a glossary and 'Test Your Knowledge' review questions, thereby receiving immediate feedback and assistance;
- collaborate with other students through a chat facility;
- consult staff.

Since its introduction in 1995, the PEW has evolved in response to feedback from students and staff. During the development and implementation phases it was extensively evaluated with respect to interface design and perceived learning outcomes. However, whether the PEW is meeting the objectives it was designed to achieve remains to be established. The study reported here is a pilot of an evaluation paradigm which it is hoped can be used to specifically address the learning outcomes achieved through the PEW.

Figure 4.1. The application of Graziano and Raulin's (1993) seven-stage model.

STAGE	DESCRIPTION	EXAMPLE
1. Idea Generation	Describing a research idea or problem in general terms.	What is the research area/question of interest? What theory do we want to test?
2. Problem Definition	Converting the idea into a form where it can be empirically tested.	What hypotheses are we going to test? How do we measure the things in which we are interested?
3. Procedure Design	Development of the research design that can be used to address our research question.	What steps do we need to take to test our hypotheses? What variables do we need to control?
4. Observation	Making observations and collecting data.	The actual experiment or study used to collect the data.
5. Data Analysis	Analysing the results using appropriate statistical tools	Organising the data in such a way that it can be used to address the hypotheses presented for testing.
6. Interpretation	Examination of the results in terms of the original research problem or question under investigation.	What do the data tell us about the hypotheses we wanted to test and how does this relate to our original research idea or question?
7. Communication	Communicating the results of the research to others.	How do we convey this information to others in an appropriate format?

3.1 Objectives of the technology-facilitated learning environment

Deakin University students have experienced difficulties with the research methodology component of the course because its presentation was largely limited to statistical analysis. Consequently, they saw little connection between 'real psychology' and research methodology and had problems understanding and contextualising statistics. The Psychology Electronic Warehouse was developed to address this problem. The main objectives of the project were to design and develop a substantial interactive resource to encourage students to make conceptual links between the discipline's fundamental knowledge base and the methodology used in psychological research. This was to be achieved by using a seven-stage research model (see Fig. 4.1) as a basis for developing 20 workshops to provide a full suite supporting the range of topics in Introductory Psychology.

From using PEW it was anticipated that students will be able to:

- demonstrate understanding of psychological concepts across a range of topic areas
- understand and apply statistical concepts and processes to research
- write a laboratory report that reflects an understanding of the nature of the research process.

4. Evaluation Plan

4.1 Objectives of the Evaluation

The focus of the evaluation was to investigate the ways in which students interact with the PEW and the impact of the workshops on students' learning processes and learning outcomes.

From the evaluation findings it was hoped to answer the following questions.

- Do students use the PEW in the way intended and does it encourage the desired learning process? In particular, do the students discern the relationship between how knowledge is gathered for the discipline and the claims we are able to make about what we know?
- Is there evidence that the PEW impacts on students' learning outcomes?
- Does computer efficacy influence how students interact with the PEW and does this in turn influence learning outcomes?
- Does a student's learning style influence how students interact with the PEW and does this in turn influence learning outcomes?

To address these questions it was necessary to determine whether students

- discern the general research model used in each of the PEW workshops?
- understand the seven stages in the model and the functions of each?
- see relationships between the stages, the tasks and decisions to be undertaken within each stage and the inter-dependencies between the activities in a stage and what occurs in subsequent stages?
- recognise that the model enables them to derive solutions for specific problems?
- can apply the model to problems they haven't previously encountered?
- view the model as purely linear or are they able to discern that the process is cyclical and iterative?

4.2 Limitations to the Evaluation

Enrolments in introductory psychology at Deakin are very large - over 1,000 every year. Students are drawn from all faculties and schools within the university and so represent a diverse group, who bring different backgrounds and interests to this unit. A further complication is the multicampus nature of Deakin University. Given that psychology students are a large and diverse group, using small numbers of students as a basis for generalising how all the other students in psychology learn is problematic. To address this problem, the evaluation paradigm that was piloted for this study incorporated some measures that allow students to be categorised according to their preferred learning styles and their confidence with using computers. In doing so it was intended that these measures would provide a basis for generalising from the smaller number of students who complete the evaluation to the larger student group.

4.3 Method

A combination of quantitative and qualitative methods was used. To address the focus and contributory questions all students enrolled in introductory psychology units on campus in

semester 2 (approximately 1,000 students) were invited to complete two questionnaires. The first assessed their level of confidence using a computer to study, and the second to classify the type of learning style the student predominantly uses. It was originally intended to administer a Knowledge pre-test/post test using multiple-choice and short answer questions designed to assess the current level of understanding of the research process. This was to provide baseline measures of the knowledge students brought with them at the beginning of the course. At the end of the course, after all students have completed PEW workshops as part of their course requirements, the knowledge test was to be re-administered. By comparing the pre- and post-test responses answers to the contributory questions can be assessed using a large group of students. However, inclusion of the Knowledge Test was not possible for the pilot study given time constraints, but will be incorporated when the evaluation is conducted in semester one next year.

4.4 Participants

All students enrolled in introductory psychology in second semester were invited to complete an online questionnaire about studying using computers. A total of 27 completed the questionnaire, which consisted of a computer self-efficacy scale and an approaches to learning measure. Of these, only four agreed to take part in the observation phase of the study (see Table 4.1). All four were female and represented "mature age" students as their ages were between 29 and 51 years. Each of the participants had a computer with internet access in their home. Two reported a high number of hours computer usage for study purposes (more than 25 hours per week) with the remainder spending 2 and 5 hours per week respectively using the computer to study. Three of the participants reported using their computer several times a week or more for surfing the internet, email and word processing. The fourth participant used a computer to perform these tasks approximately once a month.

Table 4.1. Summary statistics for computer self-efficacy measure.

		Computer Attitude Scales			
Case	Age (years)	Confidence	Liking	Anxiety	Usefulness
1	51	43	43	41	47
2	41	38	37	42	41
3	29	48	46	50	50
4	43	34	34	46	43

4.5 Screening Measures

Two measures were taken to indicate each participant's attitude towards computers and their preferred learning style. These measures were designed to provide additional information which would allow the results from a larger evaluation to be generalised to the population of interest. For the pilot they provide descriptive information that places the participant's performance into context.

4.5.1 Computer Self-efficacy

The Computer Attitude Scale (Loyd & Gressard, 1985) was used to assess each student's computer confidence, liking, and anxiety and the extent to which they perceive computers are useful. Scores on individual scales in this test can range from 10 to 50 with higher scores indicating greater confidence, liking, anxiety and perceived usefulness.

Overall the four participants in the pilot were high on computer anxiety, but were generally confident they could use computers and perceived them as very useful. Despite their level of anxiety they also scored high on the liking scale, indicating that they enjoyed working with computers.

4.5.2 Approaches to Learning

The Approaches to Studying Inventory (ASI, Entwistle & Ramsden, 1983) was used to identify the learning styles students predominantly adopt. This inventory yield 16 subscales, including Deep Approach, Inter-relating Ideas, Use of Evidence, Extrinsic

Motivation, Negative Attitudes, Strategic Approach and Comprehension Learning. For the pilot evaluation three approaches were derived from the scale information: surface approach, deep approach and achieving approach. Scores on the three subscales can range from 14 to 70, with higher scores indicating students use more of the approach in their learning. Students high on the surface approach tend to have surface motives for learning (e.g. choosing courses with job prospects in mind rather than from intrinsic interest) and adopt surface strategies to their studies (e.g. only studying what is given out in class or what is in the class outlines). A deep approach is characterised by holding deep motives for learning (e.g. wanting to know the truth or the answer) and adopting deep strategies to learning (e.g. reading material and integrating the content with previous learning from the same and other subjects). Those students who are high on the achieving approach scale tend to be motivated by the need to do well (e.g. wanting top grades to get a good job) and adopt strategies that help them to achieve their goal (e.g. working consistently through the tem and reviewing material regularly).

Table 4.2. summarises the scores for each participant on the three approaches to learning. Case 1 adopted approaches to learning that were consistent with a surface and achieving approach to learning. The other participants tended to also be high on the achieving approach, but their preferred learning style was to engage in deep learning.

Table 4.2. Individual scores for the subscales of the Approaches to Learning Scales (Entwistle & Ramsden, 1983).

Case	Approaches to Learning Scales		
	Surface	Deep	Achieving
1	41	35	45
2	35	51	44
3	39	50	48
4	36	44	47

These students then completed research methods workshop from the PEW about correlations and were observed as they used the PEW to identify patterns of interaction with the material. Observations were made over one session and interviews were conducted at the completion of the workshop to clarify or elaborate data gathered through the observation stage.

5. Results

5.1 How Students Interact with the Software

We were interested in whether students discern the general research model used in each of the PEW workshops and understand the functions of each of the seven stages in the model. In particular we wanted to know whether they see relationships between the stages, the tasks and decisions to be undertaken within each stage and the inter-dependencies between the activities in a stage and what occurs in subsequent stages. As students worked through the material the order in which they accessed the stages and the topics within each stage was recorded. What they did within each topic (e.g. read learning objectives, accessed the glossary, completed interactive activities) was recorded. At the end of each stage, before commencing the next stage the student was asked what they thought they had learnt from the stage, how this related to what they learnt in the previous stage and if there are any questions that have arisen from the material.

Without exception the students' interaction with the workshop material was linear. They started at the first stage in the model (Idea Generation), completed each topic in the order they were listed and systematically worked their way through any interactivity on each screen. Once they completed a stage they then

proceeded through the next stage in exactly the same manner. Only one student used the navigation available within the software to access topics they had already covered. This student swapped between two topics within the second stage to consolidate her understanding of the concepts of the correlation coefficient and the coefficient of determination.

5.2 What students said they learnt from each stage

Students gave very concrete answers when asked what they learnt from each stage. They tended to reply in terms of topics they covered in the stage (e.g. "It was about the correlation coefficient, how you graph correlations and why they are important in research"). However, Case 1, who scored high on the surface approach to learning gave specific and detailed responses (e.g. "Being able to identify, predict the cause. To verify the correlation between two variables, looking at establishing the validity and reliability of relationships between variables"). Unlike the other participants, this student also identified questions from each stage that had arisen from the material. This seemed to indicate that, for the approach she was using, there were gaps in what she felt she needed to know.

5.3 Learning Outcomes

The learning objective of the PEW is to help students understand research methodology as it is applied to the discipline of psychology. Evidence that this objective is being achieved would be provided by students recognising that the research model used in PEW enables them to derive solutions for specific problems and apply the model to problems they haven't previously encountered. Assessment of learning outcomes was made by asking the participants to complete a problem solving activity that required students to use the seven stage research model used in the PEW to develop a research design to address a particular research question. Performance on this task was assessed according to the extent to which students:

- demonstrate that the model is appropriate for the task and can articulate the stages in the model, the functions of each stage and the activities that should be undertaken within each stage;
- use the model to efficiently and effectively produce a research design that is appropriate and valid for investigation of the research question posed;
- understand the effect of decisions and actions in previous stages on subsequent ones;
- appreciate the iterative nature of the process.

Students were given two tasks at the end of the observational phase. The first asked them to describe the contribution correlational research can make to the area of psychology, providing examples to illustrate their point. The second described a research scenario and asked the student to describe the stages in the research process they thought the research would engage in to answer the research question, the variables they though should be measured and how these could be operationalised.

Following these two tasks, students were given a multiple choice test designed to test their understanding of the research model, the functions of the different stages and the relationships between each stage. This test was to provide a measure of the extent to which students understood the model.

5.3.1 Task 1. The Contribution of Correlation to the Area of Psychology

As part of the workshop students completed, it was discussed that correlational research can contribute to psychology by describing relationships between two variables and predicting future behaviour. It was expected that students would be able to articulate these two points, either explicitly or implicitly in their responses.

Quite varied responses were provided by students to this task. Only one of the four participants provided both contributions in their answer. This student (Case 4) responded that correlational research "… allows us to see if there is a relationship and may help with future research." When prompted as to how correlational research related to the goals of science (description, explanation and prediction) she responded that correlations could be used to predict changes in one variable as a result of changes in another. Although this is not entirely accurate, it is a reasonable approximation of the way in which correlations are used to meet the goal of

prediction. Case 2 indicated that correlations could help establish the causes of behaviour, while Case 3 indicated that correlations can "show whether there are relationships". The student with the surface approach (Case 1) used the example of diet and exercise. Although she could describe the importance of understanding how the two were linked to one another and to other health behaviours, her answer did not indicate that she understood what correlational research was used for in psychology.

5.3.2 Task 2. Applying the Research Model to a New Research Question

None of the students made explicit use of the model to describe the research process that they believed would be effective in addressing the researcher's question of what is the effect of television viewing on aggression in children. It was expected that if students understood the model and could see that it could be applied to problem solve new situations then they would describe some of the seven stages from the model in their responses. Furthermore, it was expected that they would provide specific examples of activities performed in each stage which were tailored to address the new research situation.

Only the student with the predominantly surface approach to learning (Case 1) gave a response that appeared to apply the model. In particular she said that the researcher should state her hypotheses (an activity from the Problem Definition stage), determine the characteristics of the sample (an activity from the Procedure Design stage) and then observe the children to collect the data (Observation stage). Although she skipped over the first stage in the model (Idea Generation) she described the next three in order and correctly identified important activities that need to be completed in these early stages of the research process. However, the last three stages of Data Analysis, Interpretation and Communication were not mentioned.

The other students tended to jump straight into what the researcher should do to collect data. Most of them described observing children playing and watching TV and could provide operational definitions when prompted. However, none of the students could provide a cogent description of how the data might be analysed and none saw that this might be a research situation where a correlational design might be appropriate.

5.3.3 Student's Knowledge of the Research Model

Overall, as Table 4.3 indicates, students' knowledge of the research model used in PEW was poor. In particular they could not identify the activities undertaken in the Idea Generation and Interpretation stages and confused measurement and collation of data (which is performed in the Observation stage) with analysing the results (which occurs in the Data Analysis stage). Students also did not seem to appreciate that the research process is best described as cyclical. Instead they indicated that it was a fixed series of stages or a model. Given their poor knowledge of the research model it is not surprising that they did not use the model explicitly when talking about the research process in Task 2.

Table 4.3. Participants' scores on the multiple-choice test to assess knowledge of the research model.

Case	Percentage score on research model test
1	40%
2	60%
3	50%
4	50%

On this task, which could be considered to require an understanding of the underlying process rather than just learning what each of the stages are, the student with the surface approach to learning did considerably worse than the others who indicated they favoured a deep approach to learning. However, it must be remembered that overall their performance on this task was not high.

6. Discussion

Four questions were initially proposed for this evaluation. The first was whether students use the PEW in the way intended and does it encourage the desired learning process. Related to this was the question of whether the students discern the relationship between how knowledge is gathered for the discipline and the claims we are able to make about what we know.

Students tend to adopt a very linear approach to these workshops and if the participants from this pilot are any indication, they work with the material by accessing each topic in the order listed and clicking on every piece of interactivity on the screen. However, they do not go back and review material and, apart from taking notes (which three of the four participants said they did when working with PEW), are somewhat passive in their approach. In particular, they do not seem to anticipate where the workshop may be heading and indicated this by a lack of questions at the end of each stage. For example, when the concept of a correlation coefficient was introduced in the Problem Definition stage as a way of quantifying relationships, not one student said that the question of how to calculate a correlation occurred to them. Whether this is because they already had the answer to this question through lectures or their reading is uncertain, but it does raise the issue of whether incorporating questions for consideration into the workshops may encourage students to think more about what they might encounter later in the workshop.

The responses to the two tasks indicate that students have a very superficial understanding of how the research process is related to the knowledge base of the discipline. Students hinted that they understood that we only know "things" because someone has provided research evidence to support their claim. While this was probably a difficult task, it does suggest that students need more practice and assistance applying the model to new situations. Incorporating opportunities to do this within the PEW and the other parts of the course may help students to consolidate their understanding of both the model and its potential applications.

With respect to the issue of whether there is evidence that the PEW impacts on students' learning outcomes, the very small sample used in this pilot does not allow a definitive answer to be given. If the results of the learning outcomes assessment tasks are any indication however, it is doubtful that the students have internalised the research model and as a result better understand research methodology. This is not to say that the PEW has not assisted students' learning of research methodology. All of the students report that they found the workshops very valuable for studying this part of the course. Unfortunately they all reported finding the research methods component very challenging and as a result the picture obtained in this pilot may be very skewed. However, it is not unrealistic to say that almost a quarter of students in introductory psychology struggle with the research methods component of the course, so clearly looking at ways of improving the learning outcomes for these students is very important.

The two final questions to be addressed by this evaluation were whether computer efficacy and learning style influence how students interact with the PEW and whether this in turn influences learning outcomes. Again, given the small sample size any conclusions are tentative. However, some clear differences were seen between the student who reported preferring a surface approach to learning when compared with the other students who reported they preferred a deep approach. The participants in the pilot evaluation had similar profiles on the computer self-efficacy measure so it was not possible to make comparisons with the group. In a larger study it would be useful to compare students who differ on these measures to see whether the way in which they interact with the material differs. Perhaps the linear manner in which this sample interacted with the workshop material is a result of their computer anxiety. That is, they may proceed in a systematic way in order to not get lost, skip over any material or crash the program.

6.1 Changes to the Evaluation

Following completion of the pilot evaluation, several changes will be incorporated in the evaluation when it is next administered. In particular a larger sample will be obtained, with all students enrolled in introductory psychology being invited to take part at the beginning of the semester. From the questionnaire data, an analysis of the patterns of scores on the ASI (Entwistle & Ramsden, 1983) will be undertaken to identify sub-groups of student learner types present within the student population. From the learner types identified, a sample of 30 students will be recruited. It is likely that somewhere between 3 and 5 learner type subgroups will be identified, so a sample size of 30 will allow between 5 and 10 participants to be selected for each subgroup identified. These students will then complete a previously unseen PEW workshop and while doing so will complete the activity log based on a structured

questionnaire. They will also be observed as they use the PEW to identify patterns of interaction with the material using the observational method developed for the pilot. Observations will be made over several sessions and will be used in conjunction with think aloud methods. Interviews will be conducted at the completion of the workshop to clarify or elaborate data gathered through the observation stage. Incorporation of these changes will strengthen the evaluation considerably and will provide valuable information that can be used to inform teaching practice.

6.2 Summary

The pilot evaluation provided a rich set of data that can be used to plan for changes to the workshops within the PEW. It also highlighted way in which we can develop strategies to engage students with the material and to produce learning environments that encourage students to actively participate. Although workshops in PEW contain a lot of interactive components, the level at which some students appear to be engaging with the material is only superficial. For learning to occur additional interactivity is needed. Some suggestions for encouraging students to be more active in their learning did flow from this pilot evaluation. For example, students seem to need more opportunities to practice applying the research model so that they can better appreciate the functions of each stage, the activities that occur within a stage and the interdependencies between stages.

Although time and labour intensive, there are considerable benefits to employing an evaluation plan of this kind which includes observation of the student while using the package. Some elements of the observation, such as the order in which students work through the topics, what activities they complete, the time spent on each topic, etc., can be automated. However, the presence of an academic to ask students questions is essential to be able to appreciate the learning process from the student's view point.

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