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Application of Learner-centred Principles to Post-secondary Education

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Abstract

This paper reflects upon the change of emphasis in education away from the need for students to demonstrate their recall of information set out in a syllabus, towards learner-centred education in which the students create their own knowledge.

Two cases involving post-secondary (TAFE) students are presented, to illustrate three Learner-centred Psychological Principles, namely *Construction of knowledge, Thinking about thinking,* and *Social* i*nfluences on learning*.

Case 1 showed how a computer program involving a graphical user interface enabled students to construct knowledge about binary numbers and Boolean logic by designing circuit diagrams.

Case 2 involving a course in statistics, showed how students thought about their own thinking to overcome an emotional block to their progress. This case also showed how students were able to work together in applying statistical principles to a survey of the bases upon which people selected clothes.

The change from teacher-centred to learner-centred education has altered the role of teachers from transmitting information, to providing students with suitable scaffolds which not only challenge the students but, at the same time, provide sufficient support to enable the students to succeed.

1 Introduction

In the 1960s one of the authors (HJD) had the good fortune to be involved in research in the University of Melbourne's Department of Medicine at the Royal Melbourne Hospital. It was a time of transition which raised questions like "Is it better to die with your family doctor holding your hand, or be saved by the specialist whose name you did not quite catch?" The question represented extremes of a continuum, the mode of which has moved considerably during the last 40 years.

Another continuum involved the solving of medical problems, with experimental research and case studies respectively as its extremes. Science has face credibility that creates a ring of confidence. Advertisements use statistical data to recommend a product. The metaphysical poets such as John Donne (1572-1631) used apparently unassailable truths to seduce more than just the mind. Donnes' succcess resulted in his marrying his employer's niece, Anne More, without permission, which led to a term in prison followed by a period of unemployment.

Donne expressed his situation in verse:

John Donne
Anne Donne
Undone.

Perhaps the issue is less to do with scientific method vs recollection of cases but rather to do with quantitative vs qualitative research. Most quantitative methods condense data to see the big picture whereas qualitative methods enhance data to see key aspects of cases more clearly (Ragin 1994).

2 The real versus the apparent: stated objectives versus reality

The discrepancy between the stated objectives of education and the reality of the situation has been illustrated by a paper, aptly titled, 'Becoming a Teacher' (Stringer 1996), in which a teacher reflected on his studies in 'Measurement in Education', a subject in the degree of Bachelor of Education at the University of Melbourne in the 1960s. Stringer gave two incidents to illustrate the discrepancies between educational objectives, and a) syllabuses, and b) assessment. These anecdotes are worth repeating here.

'In this subject [Measurement in Education], the staff asked us to bring in our subject statements - syllabuses, courses, anything that showed what we were trying to teach. These statements were analysed in the following week. The process challenged us to be clear about our intentions and to be clear about what it was we were asking our students to achieve - their learning outcomes. There were some red faces when some of us realised the poor nature of our objectives, but as enthusiastic young recruits to the profession our statements often contained things like "teach the students how to think for themselves", and such other hopeful statements.

The following week we had to bring in our latest assessment instruments ….and these were laid beside our objectives to see which of our objectives were actually being assessed….clearly we were all hypocrites. Nowhere did we take seriously the assessment of anything else but recall of information.'

Our paper reflects upon the change of emphasis in education away from the need for students to demonstrate their recall of information set out in a syllabus, towards learner-centred education in which the students create their own knowledge.

Two cases are presented, emphasising the use of a computer graphical user interface, and problem based learning, respectively, to illustrate three of the Learner-centred

Psychological Principles of McInerney and McInerney (2002), namely *Construction of knowledge (No 3), Thinking about thinking (No 5),* and Social i*nfluences on learning (No 11).*

3 Case 1 - Linking information to create knowledge

3.1 The task

Many TAFE students enrol to study computers because they believe them to be inherently interesting. This belief is severely challenged when students encounter binary numbers and Boolean logic which are bases on which computers are designed and constructed. The examples chosen to illustrate and explain these concepts were usually derived from electronics i.e. the very subject causing the grief in the first place. We needed examples that had a strong human component.

Binary numbers form a citadel which protects and supports those within its keep but provides formidable barriers to students trying to gain access. This seemed to be a useful metaphor for teaching binary logic, namely the decisions made by a Knight at Arms who is to storm a medieval castle and rescue a Damsel who has been imprisoned in a tower by her cruel uncle.

The students had to plan a binary tree where each node was a challenge confronting the knight e.g. **Problem 1** = moat, choice: should horse cross jump moat or swim across, **Problem 2** = wall, choice: should knight scale wall or attack portcullis. The students responded enthusiastically, especially after one student, who had studied the Arthurian legends as part of her MA (Melb), added references to Merlon and Morgan le Fey, and made the task even more interesting.

The next step was to convert the logic diagram into an electronic circuit. Fortunately, by using a software package such as EasySim, students were able to create diagrams that combined features of electrical circuits with the principles of Boolean logic.

This case illustrates Papert's (1980) concept that students are better able to build conceptual structures when they are actively engaged in creating a physical entity, in this case a simulation of an electric circuit. Here, the information is conveyed graphically which is an effective form of communication. In the diagram, when wires or components transmit or store electricity, their colour changes. This change of colour enables the students to follow the flow of electrons through wires (e.g. buses) switches, gates, and lights. The change of colour, which represents on/off states, reinforces the students' concepts of binary states represented by 0 = Off and 1 = On. This is shown in Figure 1 where the students are asked to complete the circuit. For assistance, the students can refer to the completed part of the circuit (i.e.where inputs A, B and C each = 0).

The students relished the challenge that the simulator package presented. With this package, the students were able to create circuits, such as address buses, for transmitting data from one part of a computer to another, and from a computer to its peripherals and vice versa. The students were then asked to dismantle peripheral devices, to trace the circuits, and then to reassemble the devices. In these exercises, the students were creating physical entities with their hands and thereby assisting themselves to create conceptual structures in their minds.

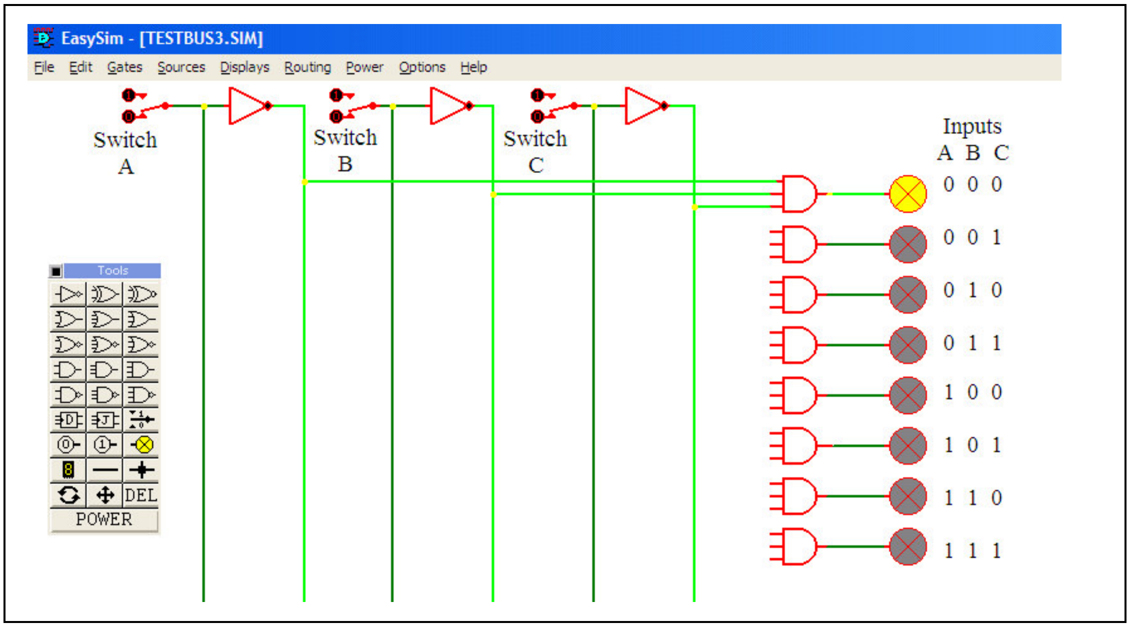

Figure 1 Circuit simulation used here as a scaffold to help students design an address bus with three inputs.

3.2 Implications of linking information to create knowledge

Many teachers know how frustratingly impossible it is to transfer the knowledge of, say, binary numbers from a textbook or whiteboard into the mind of the students, without having the students actually use and manipulate the material for themselves. On the other hand, it can be an enjoyable experience to participate with students who are actively building their own knowledge. Balzac (c. 1830) dealt with this educational issue when he described how a rich father wanted to pass on his life's experience to his son. Sadly for the father, knowledge cannot be told.

Knowing an object does not mean copying information about the object into one's mind, but means linking new knowledge about the object with knowledge that is already in the mind (Piaget 1971). This is consistent with the *Learner-centred Psychological Principle No 3* that successful learners link new information with their existing knowledge to create knowledge which is not only new, but also meaningful to the learners themselves (McInerney and McInerney 2002).

Papert (1980) held that learners are best able to link information when they build a physical entity such as a computer program, or a building, or even a representation of the movements of two windmills. Furthermore, learners are most likely to become intellectually involved when they are working on *personally meaningful activities and projects* (emphasis Papert 1991).

It follows therefore that knowledge cannot be transmitted whole from one person to another. Information can be transmitted orally, in writing, by pictures and gestures, and by shared experiences, but it is up to the recipient of this information to build it into knowledge.

Teachers can support the learners by providing them with a variety of forms of assistance. These forms of assistance are referred to as scaffolds as they provide support while the learners are building their concepts. At the same time, the teachers are challenged to provide the right form and amount of scaffold (Glasgow 1997, Hannafin, Hill and Land 1997, Saye 1997). Teachers may fail by providing learners with either too much scaffold, or no scaffold at all (Brush and Saye 2000).

The dilemma of providing a stimulating challenge within the reach of the learner being challenged has its counterpart in sport. Bobby Jones, speaking about golf courses said 'The great holes and courses should be presented to each golfer with an interesting problem which will test him without being so impossibly difficult that he will have little chance of success. There must be something to do, but that something must always be within the realm of reasonable accomplishment.' (Ward 2003).

This statement about an ideal golf course applies equally well to the scaffold in Case 1 which provided the students with sufficient material for them to be able to complete the task, but challenged them to design a graded series of electronic circuits. The knowledge acquired by designing the first circuit was enhanced as the student designed the second circuit and so on.

4 Case 2 - Thinking about thinking, and social influences

4.1 The task

Case 2 was in response to the challenge of having to teach statistics to groups of TAFE students who had a limited background in mathematics. The students needed the support of a suitable scaffold, which in turn needed to be based on something that was inherently interesting to the students, and, furthermore, would include enough information for the students to have a good chance of succeeding. Although there were text books that provided examples of a range of statistical tests, they did not seem to provide the type of scaffold that these students would require.

The first step was to have the students collect data about some area that was of interest to themselves. The next step was be to see what conclusions could be drawn from the data, and finally to apply statistical tests to see if the conclusions were valid.

What data would be of interest to the students? Preliminary questions revealed that the students were not interested in cars, but were very interested in clothes. The students were therefore challenged to survey their friends and relatives to find out how they chose new clothes. As a group, the students designed a questionnaire, but were reluctant to approach their colleagues, friends, and relatives. To overcome this emotional block, we discussed how we each felt about approaching other people. The students were surprised to discover that they each felt nervous. This discovery reduced, but did not eliminate the fear. Braver members of the class asked a few relatives, and reported their results the following week. Gradually other members of the class followed suit. Each student entered the data into the same large table, and eventually the group analysed all the data statistically. The students were interested to discover statistical relationships between the age of people and how they selected clothes.

This case used thinking about thinking (*Principle No 5* McInerney and McInerney 2002) in two different ways. By thinking about their own thinking, the students were able to overcome their emotional blocks about collecting data, and, thereby, to proceed to achieve the goals that they had set themselves.

Later, by thinking about how they decided what clothes to buy, they were able to suggest explanations for the data that they had collected. They also understood clearly how and why people of differing ages and economic situation had different criteria for selecting clothes. The students were then motivated to use spread sheets to prepare graphs to show their data, and then to apply statistical tests. They were then able to combine these criteria with demographic details of the neighbourhood to predict what markets local retailers should focus on for future business.

The enthusiastic response to the case study was reassuring at the time. Two years later, by chance, both authors of this paper met one of the students who said that most of the students in the class had gained enough confidence from TAFE to undertake higher studies. This case may have contributed to the confidence, but would not have done so if the case had not provided a scaffold that was flexible enough to encompass the needs and interests of the students.

4.2 Implications of thinking about thinking

Students benefit by reflecting on how they think and learn. Students who learn well set reasonable goals for learning and assess how well they themselves are reaching those goals. These successful learners know what to do if they are taking too long to reach a goal, and can then use other ways of reaching that goal.

The Piaget/Papert paradigm purports that reality is not simply processed, but is actively invented or constructed (Fosnot 1984). Perception (Olson 1970) and memory (Piaget and Inhelder 1973) depend on the learner's logical structures, inferences and theories. In a chemical experiment (Kuhn and Ho 1977), some children were allowed to plan their own sequence of steps, and, thereby, to test their own hypotheses. The children's partners merely copied them. When the children were tested on what they had learned, the children who had planned their own studies did better than their partners.

In learner-centred learning, errors are valued as an essential part of learning as the learners attempt to prove and disprove their own theories. The teacher should not dispense learning, but should assist and challenge the learners (Fosnot 1984), as illustrated by Case 1. Case 2 shows the importance of reflection in educational programs. As the students thought about their thinking, they set themselves reasonable goals for learning, and also assessed how well they saw themselves reaching those goals. These successful learners knew what to do if they were taking too long to reach a goal, and could then modify their procedures accordingly.

Case 2 also showed that although the students had become actively involved in planning their program for collecting their data on clothes, they stopped dead with an emotional block when it was time to interview people. Gradually the students were able to overcome the block by reflecting on, and discussing, the feelings that they had when having to approach other people for assistance. This process helped the students to form a cooperative group which worked well together in the later stages of the project. 'Learners are most likely to become intellectually involved when they are working on *personally meaningful activities and projects*' (emphasis Papert 1991).

4.3 Implications of social influences on learning

Case 1 illustrated the principle that knowledge could not be told, or transmitted, but had to be constructed by the learner *(Principle No 3)*. Part of this construction of knowledge involves thinking about thinking *(Principle No 5)* as illustrated by Case 2. These two principles converge in *Principle No 11, Social influences on learning,* namely that learning is influenced by social interactions, interpersonal relations, and communication with others. This communication may be through words, phrases, sentences, and gestures that constitute the physical signs that people use in social communication. These signs do not actually carry or contain meaning, but are parts of the code of a particular communication system (Shannon 1949, quoted by von Glasersfeld 1989).

To be able to use any particular system of communication, people have to construct the meaning of the physical signs belonging to that system. This involves considerable social interaction. Case 2 provided the social interaction for a group of students to consolidate, through discussion, their understanding of statistical terms and concepts. It could also provide teachers with an example that would help them in developing curricula that would include opportunities for social interaction that is necessary for building knowledge.

5 Reflections

Teachers cannot transmit knowledge to their students as the students have to construct their own knowledge. Teachers should provide the students with a suitable scaffold which, like a well designed golf course, challenges the students but at the same time, provides them with sufficient support to make the challenge achievable. The scaffold can enable the students to break down a problem into manageable parts. This analysis is best accomplished when the students are encouraged to reflect on their own learning, and to have social interactions with their colleagues.

The two cases discussed have been drawn from the TAFE system and raise the question as to whether TAFEs are still concerned with the construction of knowledge. This is a very relevant question as the current model for TAFE is based on Industry Training Packages which set out desired assessment criteria but do not provide any guidance as to how the students are to be prepared to meet these criteria. There are no syllabuses to indicate the subject matter.

Of some concern, the training packages leave little room for educational principles. The Faculty of Education in the University of Melbourne, for example, espouses these principles and presents them to teachers in training for primary and secondary schools. No one is training teachers for the TAFE system as Institutes of TAFE no longer require qualified, and/or, experienced teachers. In places, the term teacher has been replaced by terms such as 'assessor' which covers only one aspect of the role of a teacher, and 'deliverer' which seems to equate the provision of education with the delivery of the morning milk and newspaper.

Of even graver concern, the industrial training packages do not contain competencies such as 'Survival in the Changing Environment'. To be able to survive in the current changing environment, soundly developed concepts and an ability to think about how one thinks would be extremely helpful if not absolutely essential.

6 References

Balzac, H. de (c. 1830) The Human Comedy. Quoted by Bransford et al. (1989).

Bransford, J. D., Franks, J. J., Vye, N. J. and Sherwood, R. D. (1989) New approaches to instruction: because wisdom can't be told, in S. Vosniadou and A. Ortony, eds., Similarity and Analogical Reasoning, Cambridge: Cambridge University Press.

Brush, T. and Saye, J. (2000) Implementation and evaluation of a student-centred learning unit: A case study. Educational Technology Research and Development 48 (3) 79-100.

Entwistle, N., Entwistle, A., and Tait, H. (1993) Academic understanding and contexts to enhance it: A perspective from research on student learning, in T. M. Duffy, J. Lowyck and D. H. Jonassen, eds., Designing Environments for Constructive Learning, New York: Springer-Verlag.

Fosnot, C. T. (1984) Media and technology in education: A constructivist view. Education, Communications and Technological Journal 32(4) 195-205.

Glasersfeld, E. von (1989) Cognition, construction of knowledge and teaching. Synthese 80 121-140.

Glasgow, N. (1997) New Curriculum for New Times: A Guide to Student-centered, Problem-based Learning, Thousand Oaks CA: Corwin.

Hannafin, M., Hill, J. and Land, S. (1997) Student-centered learning and interactive multimedia: Status, issues, and implication. Contemporary Education 68(2) 94-99.

Kuhn, D. and Ho, V (1977) The development of schemes for recognizing additives and alternative effects in natural experiment context Developmental Psychology 13 515-516.

McInerney, D.M. and McInerney, V. (2002) Educational Psychology. Constructing Learning, Sydney: Prentice Hall.

Olson, D. (1970) Cognitive Development, New York: Academic Press.

Papert, S. (1980) Mindstorms: Children, Computers, and Powerful Ideas, New York: Basic Books.

Papert, S. (1991) Situating constructionism, in I. Harel and S. Papert, eds., Constructionism. Norwood NJ: Ablex.

Piaget, J. (1971) Genetic Epistemology, W.W. Norton, New York. Quoted by Entwistle, N. et al. (1993).

Piaget, J. and Inhelder, B. (1973) Memory and Intelligence, New York: Basic Books.

Ragin, C. C. (1994) Constructing Social Research, Thousand Oaks, CA: Pine Forge Press,.

Saye, J. W. (1997) Technology and educational empowerment: Students' perspectives. Educational Technology Research and Development 45(2) 5-26.

Shannon, C. (1948) The mathematical theory of communication. Bell Systems Technical Journal 27 379-423, 623-56.

Stringer, W. (1996) Becoming a teacher. Reflect 2(1) 58-61.

Ward, J. (2003) A green and pleasant 18. The Bulletin 16 Dec 2003 158-161.