

EVALUATING THE STUDENT EXPERIENCE OF SPECIFIC CDIO SKILLS FROM A PHENOMENOGRAPHIC APPROACH USING STUDENTS AS CO-PARTICIPANTS

Dennis Sale

Singapore Polytechnic

ABSTRACT

This paper outlines the evaluation approach presently adopted at Singapore Polytechnic to identify the impact of CDIO implementation on student learning. It specifically focuses on how selectively infused CDIO skills are being experienced by students in terms of their perceived relevance, the learning approaches adopted, and motivation.

To achieve an understanding of the student learning experience a phenomenographic approach is being adopted as part of the overall evaluation strategy. This seeks to explore how students perceive the infusing of CDIO skills and the responses they are making in terms of learning orientation. We are specifically interested in their approach to learning these skills (e.g., Deep or Surface and the variation involved) as well as their perception of relevance and motivation.

The research approach also includes a sample of students who are “co-participants” (a term borrowed from Lincoln, 1990, p.78) in that they are interested in the research and what it might produce. These co-participants provide regular feedback on their and fellow students experiences through a designated blog and semi-structured focus group interviews.

The research is longitudinal and will provide us with the opportunity to employ a grounded theory approach (Glaser & Straus, 1967) in which we can validate emerging theory with student co-participants.

While, at the time of writing, the research is in its earlier stages, it will provide useful insights into how evaluation of CDIO might be formulated in terms of direct exploration of the student learning experience, and what we might learn in terms of improved implementation and specific teaching practices.

INTRODUCTION

This paper documents a key component of an evaluation of a curriculum innovation based on the CDIO approach in engineering education (Crawley et al, 1) at Singapore Polytechnic. The evaluation was initiated in 2008 to provide a structured research driven approach to monitor and review the implementation of the CDIO Engineering Educational Framework at SP. The purpose and approach of the evaluation is consistent with that identified by Kemmis (2):

Evaluation is the process of delineating, obtaining and providing information useful for making decisions and judgements about educational programmes and curriculum.
(p.117)

The wider evaluation activities are presently addressing three broad research questions central to understanding the impact of key aspects of the CDIO implementation:

1. Are the learning outcomes, learning activities and assessments aligned?
2. How has the changes in the curriculum, learning activities and assessments impacted the students?
3. What are the lecturers' perception of the curriculum changes and their impact on students' competence in the selected CDIO skills and interest in the subject?

This specific research focus of this paper is on understanding the student experience of selected CDIO skills in terms of the actual learning occurring, learning approaches adopted, and relationship to teaching practices. It firstly outlines the theoretical framework, its underlying premises and rationale. Secondly, the methodology is detailed and explained in terms of the research purpose. Thirdly, it identifies emerging data trends from the initial interviews, and how the evaluation is likely to progress over time.

FRAMING LEARNING FROM THE STUDENT EXPERIENCE

The late Lawrence Stenhouse (3) once wrote:

...the central problem of curriculum study is the gap between our ideals and our attempts to operationalize them (p.3)

It is one thing to have clearly defined educational aims, but translating them into effective educational arrangements and practices which actually results in the attainment of these aims is, to use an old English metaphor, "another kettle of fish". Furthermore, in the practical context, as Prosser (4) points out:

...it is not the way we teach and design our courses that relate to the student learning experience and outcomes, but the way students perceive the teaching and the courses.
(p.39)

This is not to say that many teachers are using unsound pedagogies in the way they construct courses, design teaching strategies and organize learning environments. Indeed, we have come a long way in terms of understanding human learning and its implications for learning design and teaching approaches. For example, Marzano (5) argued that:

...over the past 3 decades, we have amassed enough research and theory about learning to derive a truly research based-model of instruction. (p.2)

More recently, Darling-Hammond & Bransford (6), from surveying the research findings, concluded that:

There are systematic and principled aspects of effective teaching, and there is a base of verifiable evidence of knowledge that supports that work in the sense that it is like engineering or medicine. (p.12)

However, while there are certain universal core principles of learning that underpin sound pedagogy, they are always mediated by the dynamics of the situated context in which learning occurs. Apart from a whole range of structural features (e.g. physical environment, resource availability, time of day, etc), there are the more ubiquitous processes of human personality, motivation and individual competences of the learners themselves. In most basic terms, while we can talk about the learning context in general terms, at the individual level it is essentially the subjective experience of each individual that is most important in learning. Hence in any classroom context, the experience of teaching will be mediated by each individual's beliefs, motivations and situated perceptions. As Prosser et al (7) suggest:

Experience is seen, not as a stable entity in cognitive structure, but as a dynamic entity relating the individual to the context in which he or she is situated. (p.51)

Csikszentmihaly's (8) framing of the human mind is an interesting one in this context:

Contrary to what we tend to assume, the normal state of the mind is chaos (p.119).

Such a view of human consciousness is also shared by Pinker (9) who asserts that:

Behavior...comes from an internal struggle among mental modules with differing agendas and goals (p.40).

In that students are making individually situated meaning out of the learning contexts in which they find themselves in, the outcomes of this process are highly significant for what teachers are trying to achieve. Glasser (10) illustrates this in stark terms when he argues that:

No teacher will successfully teach anyone who does not have a picture of learning and those who try are doomed to failure (p.41)

If students do not find personal meaning or relevance to what is occurring in a particular learning context, they simply may not pay attention or the attention will be sporadic and poorly focused. The consequences are as Sylwester (11) identifies:

It's biologically impossible to learn anything that you're not paying attention to; the attentional mechanism drives the whole learning and memory process" (p.6)

METHODOLOGICAL APPROACH

The methodological approach used in this research is within a broad qualitative paradigm, emphasizing the following key characteristics of qualitative research in that:

- The focus is on the description, understanding and interpretation of human experience in situated contexts (e.g., in this case, student's experience of teachers teaching specific skills)

- Those who are studied are to speak for themselves, to provide their perspectives through personal stories in their own words.

Within this broad paradigm, phenomenography was the main research approach employed. Phenomenography is concerned with describing qualitatively different ways (and the variation involved in these different way) in which people experience, understand and make sense of the kinds of phenomena in the world around them. While people make sense of the world based on prior experience and selective perception, etc, our common human apparatus and need orientation typically results in shared ways of experiencing the world. Indeed, without this commonality, the inter-subjectivity of everyday life would be even more problematic than it is already. Marton (12) argues that:

...we have repeatedly found that phenomena, aspects of reality, are experienced (or conceptualized) in a relatively limited number of qualitatively different ways. (p.181)

In the context of this research, the purpose was to describe, understand and interpret the ways in which students experienced the teaching of selected CDIO skills and how they went about their personal learning of them. Within the wider evaluation context, this was to identify the impact of specific curricula changes brought about by the redesign and their potential worth in terms of enhancing the quality of student learning.

Data was obtained by means of focus group interviews, drawing from a sample of 55 students. The use of a focus group was employed for the following main reasons:

- Enables the collection of data relatively quickly from a larger number (as compared to individual interviews) of research participants
- Provides a more naturalistic context than the individual interview in that it is closer to the everyday conversations that people typically participate in
- As a synergistic effect in that it allows participants to react to and build upon the responses of other group members, producing richer accounts of the experience being investigated.

The typical focused group interviews lasted around 1 hour, using the following broad structure:

- A standard opening scenario is presented to the students (e.g. have you experienced x; what does x mean to you; how have you responded to x; why did you respond to x in this way?)
- No new features are introduced – only encouragement to students to explain and provide examples
- Clarification of meaning and checking understanding where appropriate.

The data analysis involves careful reading and reflection on the original transcripts from the focus group interviews with the aim of finding stable generic categories of description (note these are formed out of an aggregate of similar perceptions, not any one perception as such). As Green (13) notes:

...the meticulous construction of categories can be framed as a particular kind of collective reflection, a particular way in which shared meaning is created (p.58)

Modifications to the typical phenomenographic approach were employed to enhance method use where appropriate. Firstly, some students (e.g., those who volunteered) took on the role of “co-participants”, a term borrowed from Lincoln (14), as they were interested in the research and what it might produce (e.g., improve their and subsequent students learning experience). I felt that this might add motivation to participate in the research activity as well as encourage openness in response behavior over time through rapport building. As the evaluation is longitudinal and may continue over the next 2-3 years, this was felt to add richness and depth to the evaluation. Secondly, certain data analysis principles were incorporated from the grounded theory approach of Glaser and Strauss (15). Most significant was the checking of conceptual understanding with co-participants to ensure that the categories of description were accurate representations of their experiences.

EMERGING CATEGORIES

At present, 4 focus group interview sessions have been conducted, involving 33 of the total 55 co-participants. All co-participants initially provide their individual experiences relating to learning the CDIO skills, until ‘theoretical saturation’ is attained (at least in that situated context). Once this has been completed, students are invited to share other experiences relating to their learning that they feel may lead to improving student learning generally in the wider polytechnic context.

In the context of this research so far, the following findings are most pertinent.

1. Variation and similarities in constructs of good thinking

The student response to the question, what is ‘good thinking’, suggests significant variation in constructs relating to what thinking is and what is good thinking. The following examples of student responses illustrate this variation:

“conscious mind, a good amount of reasoning”

“using the mind like a freight train with a checklist

“logically, systematically and creatively to solve problems”

“thinking in positive and optimistic ways

However, through more detailed exploration, two findings are becoming apparent:

- Student prior learning (including the impact of the explicit teaching of thinking) plays a significant role in their present framing of what is good thinking. For example, from the wider evaluation evidence, it is clearly the case that some staff explicitly teach the components of good thinking (e.g., specific types of thinking, dispositions relating to good thinking, etc). It may well be that this is resulting in some students using these models and incorporating the ‘language of thinking’ into their descriptions. In contrast many staff do not teach thinking explicitly. This may be related to less formalized and tidy constructs of what is good thinking.
- While there is variation in the ways students express their perceptions and experiences relating to thinking, their responses, when asked to illustrate, reveal typical and universal aspects of the way the mind works in relation to solving problems and living in the world.

For example, certain key dimensions are emerging that are consistent with the vast range of literature in the field:

- There are different broad, though related, types of thinking (e.g., critical and creative)
- There are a range of more specific types of thinking (e.g., analysis, comparison and contrast, inference and interpretation, evaluation, generating possibilities, etc)
- Thinking is affected by other human attributes (e.g., perseverance, optimism, etc)
- Thinking has internal organization (e.g., conscious self-directed activity is important in good thinking – whether it be systematic, or ‘thinking out of the box’)
- Thinking involves making connections with knowledge.

2. The impact of teaching on shaping the subjective experience of learning

A major finding from the interviews confirms the powerful impact that individual lecturers make on the ways in which students experience their learning in classrooms, irrespective of subject context. While, there is agreement among students that some subjects are “drier” than others, how the lecturer teaches (the types of strategies used, human conduct, etc) significantly impact attention, subsequent forms of engagement and learning, and the learning approaches adopted. While many factors influence student learning orientation (e.g., prior experiences, motivations, etc) there is much in the situation that can impact what is learnt and how, and most importantly, teachers are the most significant agents in the construction of these individual student experiences. This is consistent with an increasing body of research, which highlights the high level of effect that individual teachers have on student learning and attainment. For example, Izumi & Evers (16) point out

...nothing is as important to learning as the quality of a student’s teacher. The difference between a good teacher and a bad teacher is so great that fifth-grade students who have poor teachers in grades three to five score roughly 50 *percentile points* below similar groups of students who are fortunate enough to have effective teachers (ix)

Similarly, Rivers & Sanders (17), document:

The effect of the teacher far overshadows classroom variables, such as previous achievement level of students, class size...heterogeneity of students, and the ethnic and socio-economic makeup of the classroom. (p.17)

IMPLICATIONS FOR TEACHING & LEARNING

The importance of understanding how students are experiencing aspects of our courses and teaching has significant implications for the enhancement of practice and the possibility of helping students to be better learners. As in any human performance activity, there are better and worse ways of doing things – some ways are even dysfunctional to the performance. This applies equally to the process of learning. As Prosser and Trigwell (18) point out:

...there are better and worse ways for students to approach their learning – a deep approach being better than a surface approach (p.7)

Given that student approaches to learning are based on the prior experiences and perceptions of their situation in a learning context, the challenge for teachers is to create learning experiences that encourage – even demand – better approaches to learning. This is certainly possible as Prosser and Trigwell (18) argue:

...approaches to learning are not stable characteristics of students. Students *approaches* to learning do change with changes in perception of their learning situation and their perception of it can be changed by...teachers. (p.83)

While we can never design learning experiences that are going to get desired results with all students, we are in a position to inform practices based on a better understanding of our students experiences and the meaning they are making of their time in our classrooms. In terms of a broader approach to pedagogic practices, we can move to a position where we can draw both upon an increasingly empirical base of knowledge about human learning, as well as the situated realities of the student we teach, in improving the quality of student learning outcomes. As Marton (19) suggests:

It is only when we have a fair understanding of what learners are expected to learn, what they actually learn in those situations and why they learn something in one situation but not in another that pedagogy becomes a reasonably rational set of human activities. (p.22)

REFERENCES

1. Crawley, E. Et al., Rethinking Engineering Education, Springer, New York, 2007
2. Kemmis, S., 'Seven principles for programme evaluation in curriculum development and innovation'. In House, E. R. New Directions in Educational Evaluation, The Falmer Press, London, 1989.
3. Stenhouse, L., An Introduction to Curriculum Research and Development, Heinmann Educational Books, Oxford, 1989.
4. Prosser, M., 'Experiencing Teaching and Learning in Higher Education'. In Frontiers in Higher Education, International Conference on teaching and Learning in Higher Education, CDTL, Singapore, 2008.
5. Marzano, R. J., A Different Kind of Classroom, Alexandria, ASCD, VA, 1992.
6. Darling-Hammond, L. & Bransford, J., Preparing Teachers for a Changing World: what teachers should learn and be able to do, Jossey-Bass, San-Francisco, 2005.
7. Prosser, M. et al., 'Academics experience of teaching and their subject matter understanding'. In Entwistle, N. & Tomlinson, P. Student Learning and University Teaching, The British Psychological Society, Leicester, 2007.
8. Csikszentmihalyi, M., Flow: The psychology of optimal experience, Harper Row, New York, 1990.
9. Pinker, S. The Blank Slate: The modern denial of human nature, Penguin, London, 2002.
10. Glasser, W., Choice Theory in the Classroom, Harper Paperbacks, New York, 1998

11. Sylwester, R., Student Brains, School Issues, Skylight Training and Publishing Inc, Arlington Heights, IL, 1998.
12. Marton, F., 'Phenomenography – Describing conceptions of the world around us'. In Instructional science 10, 1981, 177-200. Elsevier Scientific Publishing Company, Amsterdam, 1981.
13. Green, P., 'Phenomenography as seen by an action researcher'. In Bowden, J.A., and Green, P. Doing Developmental Phenomenography., RMIT University Press, Melbourne, 2005.
14. Lincoln, Y. S., 'The Making of a Constructivist: A Remembrance of Transformations Past'. In E. G. Guba (ed.) The Paradigm Dialog, Sage, London, 1990, p.78.
15. Glaser, B. and Strauss, A., The Discovery of Grounded Theory, Aldine: Chicago, 1967.
16. Izumi, T. L. & Evers, W. M., Teacher Quality, Hoover Institutional Press, San Francisco, 2002
17. Rivers, C. J. & Sanders, W., 'Teacher Quality and Equity in Educational Opportunity: Findings and Policy Implications'. In Izumi, T. L. & Evers, W. M., Teacher Quality, Hoover Institutional Press, San Francisco, 2002.
18. Prosser, M. and Trigwell, K., Understanding Learning and Teaching: The experience in Higher Education, Open University Press, Buckingham, 1998.
19. Marton, F., 'Towards a Pedagogic Theory of learning'. In Entwistle, N. & Tomlinson, P. Student Learning and University Teaching, The British Psychological Society, Leicester, 2007.

