

Using action research to improve engineering education

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Abstract

In this paper the author summarises the notion of action research and shows how engineering educators can benefit from undertaking collaborative action research projects. The circumstances and setting in which faculty members discuss this type of research and help each other carry out and evaluate their own efforts are discussed. The idea of adding value to what they do by publishing their work and spreading it among other faculty members is also referred to. Some examples of projects are given to show that teachers at technical universities can benefit their teaching via action research while at the same time developing their pedagogical merit portfolio.

Introduction

Action research is something I learned about as a PhD student. Although my research was mainly historical I taught a number of tutorials at the Education Faculty where I studied (Monash University, Australia). It was the mid 1970's and the authors that I was drawn to at that time included Paolo Freire, John Holt, Ivan Illich and Neil Postman. Just the title of Postman and Weingartner's book *Teaching as a subversive activity* would arouse the interest of the CIA today. It was the first time I heard Freire's notion of 'Participatory action research' and understood that there were some researchers who neither aspired to nor believed in 'objective research'. For them the term was an excuse to prolong the hegemony of a powerful intellectual elite at the expense of intelligent but illiterate people. At that time I had no kids but lots of opinions. I subscribed to the 'deschooling movement' and advocated it in my tutorials.

I am sure my position went down well with the younger students but I remember the quizzical looks of one or two older women who only managed to undertake teacher training because their children were being well looked after at school. In the mid 1990s I came across Jean McNiff's book *Teaching as learning: an action research approach* (1993) and was impressed by her argument that teachers could, via collaborative action research projects, improve their teaching and learning. In that same year Stephen Kemmis published an article on 'Action research and social movement: A challenge for policy research' (1993) in which he summarised the development of action research and concluded that 'emancipatory action research is always connected to social action: it always understands itself as a concrete and practical expression of the aspiration to change the social (or educational) world for the better through improving shared social practices, our shared understandings of these social practices, and the shared situations in which these practices are carried out'.

It is appropriate, in the context of this paper, that the so called father of action research, Kurt Lewin (1890-1847) should have been an MIT professor. The paper that earned him

that title was published in 1946 and is called ‘Action research and minority problems’. In that paper Lewin explained that action research consists of ‘a spiral of steps, each of which is composed of a circle of planning, action, and fact-finding about the result of the action’. He spoke about the difficulty of changing ideas and social behaviour that had become fixed or normalised. Most change begins with a disorientating dilemma and the need to do something about it. It might be, as in the case of one of the projects undertaken by teachers on my course, that a course organiser invites a number of guest lecturers to provide the best possible expertise for his students but in fact their uncoordinated input ends up confusing rather than enlightening the students.

Action research

Lewin describes the process of realising a dilemma or problem and wanting to do something about it as the ‘unfreezing’ of a mindset or situation. Given the raised consciousness that occurs once the problem is identified the action researcher sees the need to diagnose the situation and come up with new ways of dealing with it. Action is initiated and the results are collated and analysed. The new behaviour, in its turn, is likely to become frozen, hence the need for a feedback loop and the continuing spiral of reflection, action, analysis and further action.

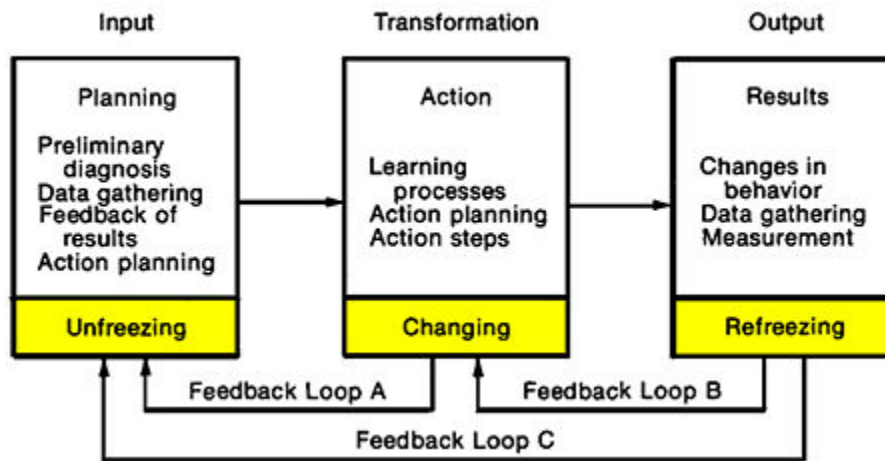


Figure 1: Systems Model of Action-Research Process (Source: Wikipedia on Action research)

In the course TLC101 Pedagogical Project, which forms part of the Chalmers Diploma of Higher Education, teachers are introduced to the notion of action research and provided with a simple textbook on the subject (Costello, 2003). Since they are new to qualitative research their first session in the course focuses on how the natural and human sciences carry out research. In that session we also go through some of the basic techniques of qualitative research and focus on a problem they wish to solve using action research or a similar method. On the second day of the course they go over their chosen topic and attend an information literacy session presented by a university librarian. In this session they are shown the online facilities of the university library and how to access key databases. Simple ways of accessing reputable sites on the internet is also part of the lecture.

From the outset I make it clear that action research is one method of carrying educational research and that they are free to use others. However I recommend it because of its clearly stated purpose to 'make a difference' and its attitude towards collaboration and the sharing of information. This collaboration is multifaceted and longitudinal. The teachers share information as they carry out their project with their informants and departmental colleagues as well as with their classmates and myself. They present a preliminary report after two months and a final verbal and written report at the end of the year long project. If the project is good enough it is published and distributed online in an edited compendium. The publication is not seen as an end of the project but rather the reporting and distribution of the results from the first cycle of research.

From a glance at the contents page of the first publication to come out of TLC 101 Pedagogical Project, namely, *Shifting perspectives in Engineering Education*, 2006 it is clear that much of the research concerns curriculum reform. However there are also projects on the use of Information Communication Technology in facilitating learning, as well as projects that focus on ways of improving supervisory practice. Some of the project titles include:

- Factors involved in curriculum reform: a case study from chemical engineering
- Experiences from the transformation of an engineering education introductory project design course into a project design-build-test course
- Development of a new course in Process control and measurement techniques: lifting the level of comprehension to a system level
- Activating learning: the response of students on a new project course in pharmaceutical technology
- Assessing Lectures, a case study on the students perception
- Constructive alignment in an Engineering Education masters course
- Development and reformation of an existing course in process technology for drinking water and waste water treatment
- Using learning platforms in optional language courses
- Acoustical Movies for Outdoor Sound Propagation
- Improving the teaching and learning of Fiber Optic Communication
- using computer simulations
- Revised Chemical Reaction Engineering: Integration of Mathematics and Numerical Analysis with the use of Tutorials
- The use of learning management systems in Engineering Education: A Swedish case study
- Becoming a doctoral student. Why students decide to do a PhD
- Group supervision of industrial PhD students
- Junior research teams; a new form for the Bologna candidate exam work
- Criteria for the recruitment of creative researchers

The published compendium becomes a source of inspiration for the next year's intake of participants in the course and also has the effect of subtly raising the standards of the research and reporting. A second compendium, that will include projects from the 2006 and 2007 cohorts, is planned for January 2009. The current course has just over thirty

participants. Most carry out individual projects but occasionally teachers with common interests carry out a joint project.

Participant reflections on the value of the project

In this concluding section I provide unedited reflections by some of last year's participants on the benefits of carrying out this type of action research. Many projects are evaluative in that small changes are made to improve courses and the results are tested via formative interviews, focus groups, surveys and questionnaires. Although this is often a first attempt by natural scientists to carry out an educational reform project the quality of the research is surprisingly high. The course emphasises that the process of doing the research is just as important as the product and that there is nothing wrong with reporting on a project that they feel is not really 'finished'. Indeed the nature of action research implies that projects are never really finished. Hopefully the first cycle will throw up more issues that can be investigated and improved on. As part of the course the participants are asked to critically reflect on the process they have undergone during their year long project work. Here are some of their responses:

'The Pedagogical Project course (TLC101) gave me the opportunity to carry out a small but fairly well-defined action research project. One of the most important things that I learnt was how to organise and how to outline such a project. My project was fairly small and only covered one classroom session but that was also one of the main advantages because it made it possible to control some variables that I wanted to control. The size of the project was thus an advantage from the perspective of manageability, but at the same time it became quite clear that an extended, possibly longitudinal, study of this type involves a great many difficulties'.

'Knowledge and understanding of action research gives tools to evaluate and re-plan courses in a structured way. I believe that I am more aware of the need to reflect on a regular basis on how courses and lectures can be improved'.

'The project has forced me to approach some issues which I would have done anyways but probably not as thoroughly. The project let me spend time on important course development and thinking that I would not have prioritised this much without the 'pressure' from the course. Beside my (our) own project, the other participants' projects have been very inspiring and maybe, from a teacher perspective, you learn as much, or even more, from these others' challenges and problems, as from the work with your own project'.

'My main interest in active research projects has been to use it as a tool to improve my teaching and, in particular, my lecturing style. Having said that, I will definitely also use it in my strive to improve the organization of my courses'.

'In an action research project you evaluate your own performance which usually involves some difficulties as the object of study are you! Besides that, evaluation in general means that you need to be very clear about what you want to evaluate and how to do it.

Evaluation in my particular case meant to measure students expectations in the beginning, the students "mood" in the middle of the course and their final reflection on the course'.

'As a more general reflection I think the most important one I have made is: How little time there is for reflection!'.

‘Every now and then most teachers, I hope and believe, get ideas on how to improve their teaching. I think that the most important outcome of my project was that I actually got one of those ideas into something real. Without the deadlines of a project there is a slight risk that some ideas might never become realized’

‘The very idea of the course is definitely healthy – get together teachers and researchers to discuss and share their pedagogical experiences and problems and let everybody to work on a project directly concerning real-world pedagogical practice. Even for an experienced teacher it is useful to be placed in such a challenging environment where key issues of modern pedagogy are stated sharply and discussed by a group of motivated participants led by a skilful instructor. Perhaps the most valuable perception gained by me through this and other pedagogical modules is that the teacher’s prime responsibility is to FACILITATE STUDENT LEARNING’.

‘I have learned from the interaction with the other students in the pedagogical project course. It has been fruitful to give comments on each other’s projects and to share experiences with each other. The presentations of good examples have been inspiring for my own teaching and I got several ideas that I would like to try in my own course, e.g. on how to make more interactive teaching’.

Conclusion

In this paper I have reported on a course for engineering educators in which they are helped to understand the action research process and use it to improve some aspect of their teaching or research. Designing and managing the TLC101 course is important given the fact that the participants are not provided with any time off from their normal research and teaching duties. The course stretches over a year so that those who want to carry out formative evaluations can do so during a semester or even compare changes that are made in two courses from different semesters. In order to keep reminding the teachers that they have a project to carry out we have a series of half day workshops over the year. After an initial two full days where they learn about action research and kick start their project they give a preliminary report on their progress and literature search in November, as well as meeting again in February and April. The reports are expected at least two weeks before the final presentations in June. The participants can also interact on the PingPong learning platform but unless a special exercise is set for this there is not a lot of activity there. It is clear from the comments above, that meetings which are interspersed over the year are important staging posts and that the participants learn a great deal from hearing about progress in the other projects on a regular basis.

Acknowledgements

Although the names of the authors are not included in the list of project titles given above I wish to acknowledge the enthusiasm and skilful engagement of all the teachers and researchers who have taken TLC101 Pedagogical Project. Many of the projects have had a lasting impact on the improvement of teaching, learning and supervision at Chalmers.

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