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Congruence between intention and strategy in university science teachers' approaches to teaching

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Abstract. This paper describes the results, and some implications, of an empirical study of the congruence between intention and strategy of university science teachers' approaches to teaching in their first year science courses. The study drew upon the results of a previous phenomenographic study which identified qualitatively different approaches to teaching. An approaches to teaching inventory was subsequently developed which included scales representing the intentions and strategies identified in the first study. This inventory was distributed to a sample of university teachers of first year science courses in Australia. The results confirmed the proposed relationship between intention and strategy, and showed that a Student-focused Strategy was associated with a Conceptual Change Intention, while a Teacher-focused Strategy was associated with an Information Transfer Intention. It is concluded that the traditional form of academic development focussing on teaching strategies (for example, activity based strategies) is unlikely to be successful without an ongoing focus on the intentions which are associated with the strategy.

Introduction

In attempting to improve the quality of teaching in higher education, much of the research and development has focused on the improvement of teaching strategies (Brown, Bakhter & Youngman 1982; Dunkin 1983). The intentions associated with the use of particular strategies has rarely been the focus of research and/or development activities, although Ramsden (1992) has begun to address such issues. Strategies have been seen to be the figure and intentions the ground in most of the research and development activities in higher education (see, for example, Bligh 1971). The research on student learning in general, and students' approaches to learning in particular, has shown the importance of reversing this figure/ground relation in student learning. Students' intentions, as well as strategies, have been shown in both qualitative and quantitative studies to be important in the determination of students' learning outcomes (Biggs 1993).

The student learning research has identified two qualitatively different approaches to learning, labelled surface and deep. These approaches have been identified in reading tasks (Marton & Säljö 1984), in other studies of

specific learning tasks (Entwistle & Ramsden 1983) and in approaches to study in general (Biggs 1987). In both these specific and general cases the approaches are seen to be composed of two components: an intention or motive (why the person adopts a particular strategy) and a strategy (or what the person does). More recently, Biggs (1993) has discussed the relationship between intention and strategy in students' approaches to learning in the context of discussing what responses to inventories of student learning approaches really mean. He makes the point that the meaning of a particular strategy is related to the intention underlying the strategy. The quality of the learning outcome depends on the intention as well as the strategy.

In a Presage, Process and Product model of teaching, Biggs (1989) discussed approaches to teaching in a structurally similar model to approaches to learning: The implication being that approaches to teaching also have intention and strategy components, and that the intention is an important part of the approach. While there have been a number of empirical studies of university teachers' conceptions of teaching (for example, Samuelowicz & Bain 1992; Gow & Kember 1993; Prosser, Trigwell & Taylor 1994), there have been few, if any, empirical studies of university teachers' approaches to teaching, and the relationship between intention and strategy in teaching. Judged by the results of the student learning research, the identification of the intentions underlying various teaching strategies should be a vital part of activities aimed at improving university teaching. This paper discusses the results of both a qualitative and a quantitative study of university science teachers approaches to teaching and, in particular, the relationship between intention and strategy in those approaches.

Qualitative study

A phenomenographic study of the conceptions of learning and teaching, and approaches to teaching of 24 first year university science teachers was conducted. Teachers' approaches to teaching in first year university physics and chemistry courses were constituted from an analysis of their interview transcripts. Like students' approach to learning, the teachers' approaches to teaching have been analysed in terms of the strategies they adopt for their teaching and the intentions underlying the strategies (Trigwell, Prosser & Taylor 1994).

The intentions were found to range from one in which the teacher wants to transmit the content of the subject to the student, to one in which the teacher aims to help students' change their conceptions of the content. The strategies ranged from one in which the students are the focus of the activities to one in which the teacher is the focus. Each of the approaches is described briefly in

Figure 1, and relations between strategies, intentions and the five approaches (A–E) are illustrated in Table 1.

Each of the Approaches A–E are qualitatively different from the others, but like conceptions of learning (Säljö 1979), the five approaches fall into two distinctly different groups. The first group (Approaches A–C) focuses on the teachers, or on the interaction between the teacher and the student, and represents teaching as being mainly about passing on knowledge. (During the development of the categories of description there was considerable discussion about the intentional component of Approach C. It was accepted that it was "on the balance of probabilities" rather than "beyond reasonable doubt" that its intention was Concept Acquisition rather than Conceptual Change). The second group (Approaches D and E) focuses on the students, and represents teaching as helping the student develop their own knowledge. Both groups have their own internal structure (Approaches A and B share a common strategy, Approaches B and C share a common intention, Approaches D and E share a common strategy). Significantly, however, there is neither a common strategy nor intention between the two groups, and there were no approaches identified from the transcripts which bridged the two groups (for example a Conceptual Development Intention with a Teacher-focused Strategy). These two distinctly different groups of approaches reflect, to some extent at least, those identified for students' approaches to learning. In particular the first group (Approaches A, B and C) seem to have characteristics in common with a student's surface approach to learning. Approaches with a Student-focused Strategy (Approaches D and E) seem to have characteristics in common with a student's deep approach to learning. If teaching is less about what the teacher does (what might be described as the signs of teaching) and more about what the students do in relation to the teaching (what might be described as what is being signified in the teaching), then the relation to surface and deep approaches to learning become apparent.

This suggests that teachers who adopt a Teacher-focused Strategy are more likely to encourage students to adopt a surface approach to learning than those who adopt a Student-focused Strategy. This hypothesis is the focus of a project of which this study formed a part. It necessitates the economical collection of approaches to teaching data on a large scale. The qualitative method used in the first stage of the study is unsuitable. The development of a quantitative approach (an inventory of approaches to science teaching), based on the intentions and strategies found in the phenomenographic study, was explored and is discussed in the quantitative study section of this paper.

A: Teacher-focused strategy with the intention of transmitting information to students

This approach is one in which the teacher adopts a teacher-focused strategy, with the intention of transmitting to the students information about the discipline. In this transmission, the focus is on facts and skills, but not on the relationships between them. The prior knowledge of students is not considered to be important and it is assumed that students do not need to be active in the teaching-learning process.

B: Teacher-focused strategy with the intention that students acquire the concepts of the discipline

This approach is one in which the teacher adopts a teacher-focused strategy, with the intention of helping their students acquire the concepts of the discipline and the relationships between them. These teachers assume that their students can gain these concepts by their telling their students about the concepts and their relationships. Like Approach A they do not seem to assume that their students need to be active for the teaching-learning process to be successful.

C: A teacher-student interaction strategy with the intention that students acquire the concepts of the discipline

This approach is one in which the teachers adopt a student-teacher interaction strategy to help their students acquire the discipline based concepts and the relationships between them. Like Approaches A and B, students are not seen to construct their own knowledge, but unlike Approaches A and B they are seen to gain this disciplinary knowledge through actively engaging in the teaching-learning process.

D: A student-focused strategy aimed at students developing their conceptions

This approach is one in which the teachers adopt a student-focused strategy to help students further develop the world view or conception they already adop. A student-focused strategy is assumed to be necessary because it is the students who have to construct their knowledge in order to further develop their conceptions.

E: A student-focused strategy aimed at students changing their conceptions

This approach is one in which teachers adopt a student-focused strategy to help their students change their world views or conceptions of the phenomena they are studying. Like Approach D, students are seen to have to construct their own knowledge, and so the teacher has to focus on what the students are doing in the teaching-learning situation. A student-focused strategy is assumed to be necessary because it is the students who have to re-construct their knowledge to produce a new world view or conception. The teacher understands that he/she cannot transmit a new world view or conception to the students.

Figure 1: Approaches to teaching in first year university science.

Quantitative study

Development of the approaches to teaching inventory

The original source of items for the inventory was the set of transcripts of the interviews with the science lecturers. For each of the intention and strategy

Table 1. Approaches to teaching illustrating relations between intention and strategy

Intention	Strategy		
	Teacher-focused	Student-teacher interaction	Student-focused
Information transmission	A		
Concept acquisition	B	C	
Conceptual development			D
Conceptual change			E

categories identified in the phenomenographic study, statements or phrases were extracted from the transcripts which typified that category. One hundred and four of these statements were selected and discussed by the researchers with the aim of reducing overlap and improving clarity. In the first item review, the number was reduced to 74 items in the following sub-scales:

Information Transmission Intention (IT)
Concept Acquisition Intention (CA)
Conceptual Development Intention (CD)
Conceptual Change Intention (CC)

Teacher-focused Strategy (TF)
Student-teacher Interaction Strategy (ST)
Student-focused Strategy (SF)

In a second review, the face validity of the items was examined by each author rating each item twice – the first time adopting the perspective of Approach A and the second by adopting the perspective of Approach E. After comparing the ratings of each item among the raters, it was decided that the items in the middle two intention sub-scales were not reliably rated by the authors, and they were rejected. This resulted in the first version of the inventory which contained 49 items and five sub-scales.

The 49-item version was then sent to eleven of the staff who were originally interviewed. All five approaches identified in the original study were represented in the group. After completing the inventory the staff were asked for their general comments and asked to identify any items they thought were problematic. The results of the analysis of the inventories were compared with the qualitative analyses done on the transcripts, and the items further culled to increase the face validity of each sub-scale.

Table 2. Examples of items from the final form of the approaches to teaching inventory

Information Transmission Intention (6 items, α = .74)
IT1. In this subject I aim to give my students a detailed coverage of the syllabus
IT4. I think an important reason for giving lectures is to give students a good set of notes
Conceptual Change Intention (4 items, α = .61)
CC1. The tutorials in my subject should be a time for students to discuss their changing understanding of the subject
CC2. I feel that examinations should be an opportunity for students to reveal their changed conceptual understanding of the subject
Teacher-focused Strategy (4 items, α = .57)
TF1. I design my teaching with the assumption that students know very little of the subject
TF4. I structure my subject to help students pass the exam
Student-Teacher Interaction Strategy (3 items, α = .56)
ST1. I spend time in my subject getting students involved in activities such as classroom demonstrations
ST2. I spend a substantial amount of time involving students in lectures by asking them questions
Student-focused Strategy (5 items, α = .67)
SF2. I attempt to persuade students in my subject that their learning should be a self-directed process
SF1. We take time out in lectures so that the students can discuss, among themselves, the problems they encounter studying the subject

A 39-item inventory, still in five sub-scales was then sent for trial to a selection of Chemistry and Physics Departments throughout Australia. The analysis is based upon 58 inventories, including 11 from the original study. The data were analysed using correlational analysis to look at the relationship between pairs of sub-scales and principle components analysis to look at the underlying pattern of relations between the sub-scales.

Analysis of data

As a result of a series of item reliability analyses aimed at reducing the size of the inventory, while retaining its reliability, the inventory was reduced to 22 items representing five sub-scales. Examples of items from each of the five sub-scales and internal consistency reliabilities are shown in Table 2.

Table 3. Correlation matrix of sub-scale scores

Sub-scale	Sub-scale				
	IT	CC	TF	ST	SF
Intention					
Information Transfer (IT)	–	–.17	.61***	–.13	–.19
Conceptual Change (CC)		–	–.22	.29*	.45***
Strategy					
Teacher-focused (TF)			–	–.10	–.23
Student-Teacher Interaction (ST)				–	.73***
Student-focused (SF)					

* $p < .05$; ** $p < .01$; *** $p < .001$
n = 58.

Table 4. Principal components analysis of inventory sub-scales

Sub-scale	Principal components	
	1	2
Information Transmission		88
Conceptual Change	62	
Teacher-focused		89
Student-teacher Interaction	87	
Student-focused	91	

Principal Components Analysis with Varimax Rotation.
Eigen values>1 (2.27, 1.36).
Decimal points and loadings less than .30 not included.
Two principle components explained a total of 73% of the variance.
n = 58.

Table 3 shows Pearson correlation coefficients between the sub-scales. This analysis shows a substantial, positive and statistically significant correlation between the Information Transfer Intention and Teacher-focused Strategy sub-scales ($r = .61$, $p < .001$). It also shows a substantial, positive correlation between the Student-Teacher Interaction Strategy and the Student-focused Strategy sub-scales ($r = .73$, $p < .001$). Finally it shows substantial, positive and statistically significant correlations between the Conceptual Change Intention sub-scale and the Student-Teacher Interaction Strategy and Student-focused Strategy sub-scales ($r = .29$, $p < .05$; $r = .45$, $p < .001$). These results are consistent with the proposed congruence between the intention and strategy sub-scales.

As a way of further exploring this congruence, Table 4 shows the results of principal components analysis of the sub-scale scores using varimax rotation.

This principal components analysis shows clearly the relationship between intention and strategy. It shows the Conceptual Change Intention, Student-Teacher Interaction Strategy and Student-focused Strategy sub-scales loading heavily on the first principle component and the Information Transfer Intention and Teacher-focused Strategy sub-scales loading heavily on the second principal component. This is consistent with the idea that an approach to teaching is composed of congruent intention and strategy components. It should be noted, however, that the Student-Teacher Interaction Strategy loads with the Conceptual Change Intention and Student-focused Strategy rather than with the Information Transfer Intention and Teacher-focused Strategy.

Discussion and Conclusions

The results of the analysis of the inventory are consistent with the results of the earlier qualitative study, and with the congruence of the relations between intention and strategy found in that study. It confirms that the strategy adopted by these teachers matches the intention they have for their teaching. It is noteworthy that in neither study was there support for relations between either a Teacher-focused Strategy and a Conceptual Change Intention, or for a Student-focused Strategy and a Information Transmission Intention. Both studies revealed only the logical relations between intention and strategy.

The only substantive difference between the qualitative and quantitative studies was the place of the Student-Teacher Interaction Strategy within the structure of the sub-scales. It is not clear whether this is due to a problem with the qualitative analysis or is an artefact of the different methods of collecting data. In the qualitative study, the teachers were responding to open-ended items. In the quantitative study they were responding to closed-ended items. It would not be unexpected that differences may arise in the results because of these methodological differences. On the other hand, we did note that we were somewhat uncertain in the qualitative study whether Approach C had an intention to acquire concepts or develop concepts. It may well be that this strategy signifies a transition in the teachers underlying intention for his/her teaching.

The relations between intention and strategy caused some problems with the responses of some staff to the inventory, but at the same time offer an explanation for their responses. Some items in the inventory asked staff to comment on the extent to which they engage students in learning tasks which are active rather than passive. For example, "We take time out in lectures so that students can discuss, among themselves, the problems they encounter studying the subject" (SF1). Staff who have the intention to transmit information do not see the value of, or need for, this type of activity, and

responded to this item on the inventory by saying that such an activity was not possible in lectures and that the inventory was flawed because it was unrealistic.

Despite the small number of spoiled copies returned, the inventory proved to be sufficiently robust to be acceptable to most staff and to discriminate between those staff who were found in the qualitative study to be at the extremes of intention and strategy. It should be noted however, that the inventory was developed from a relational study, the results of which are not necessarily transferable to other contexts, and it was specifically designed for a study of approaches to teaching in first year university science classes. Whether it would be a valid and reliable instrument for other forms of teaching would need further consideration.

The importance of the relationship between intention and strategy for student learning has been noted elsewhere (Trigwell, Prosser & Taylor 1994). The focus of much academic development work is an increase in the quality of student learning through the improvement of teaching. The implications of these results for academic development is that just helping academic staff become aware of, or even practicing, particular strategies will not necessarily lead to substantial changes in teaching practice. The associated intentions or motives also need to be addressed. Attempts by academic developers to introduce more student-centred activities into teaching demonstrate some of the problems which can arise from a strategy-based approach. Buzz groups, which are short sessions in which students are asked to form small groups to discuss a key issue being addressed in a teaching session, are an example of such an activity. A second activity being advocated is the incorporation of "rest-times" in long lecture slots to help maintain student interest in the lecture by providing a variation in stimulation (Bligh 1971, p. 50). Suggested activities for this "rest-time" are buzz groups. Such a suggestion to a teacher with an information transmission intention, if it is accepted at all, is likely to result in the adoption of the buzz group as a strategy to keep students from becoming bored with the lecture, rather than as a method to help the teacher find out about students' prior knowledge, or for students to become aware of the variation of the conceptions among their peers, or as a way of developing discussion among students.

For these reasons, improvements in teaching may be conceived of as requiring a conceptual change on the part of some teachers. Evidence from other research suggests that such changes are difficult to bring about, and are unlikely to occur through the attendance at, and participation in the occasional three-hour professional development workshop. A much more sustained and systematic approach is required, built upon teachers examining and critically reflecting on their own practices and the outcomes of those practices.

Attempts at more systematic and coherent introductions to teaching are underway with the development of postgraduate courses in higher education for practicing university teachers in which the course-work has been developed as an experiential learning activity for those staff (Andresen 1991).

Other authors (Gow & Kember 1993) have argued for the need for changes in the conceptions of teachers in order to get improvements in student learning. While this may be true in some cases, it is based on an as yet to be established relation between the conception of teaching and the intention in teaching of a member of staff. Unpublished results from a study conducted by the authors of conceptions of teaching and approaches (intention and strategy) to teaching of science teachers suggest that the intention, like the approach, is context dependent. A member of staff with a conception of post-graduate teaching as being the facilitation of student learning, may decide that at first year level, the intention and the related strategy is to transmit information. This may be due to a different conception of teaching at the first year level (ie. students need to know the basics first, and that needs to be transmitted to them), but since this teacher already works with a higher conception of teaching, to change their teaching at first year level involves conceptual development rather than conceptual change, and this is a much easier task.

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Notes

[1] The version of the inventory currently being used is conceived of as comprising two scales, one indicating an Information Transmission/Teacher-focused approach to teaching and the other a Conceptual Change/Student-focused approach. The internal consistency reliabilities of the two approaches scales are .81 and .75 respectively.

[2] The version of the inventory used in this study is available from the authors.

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