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# Technology Students' Views of Intelligence and the Implications for Classroom Practice

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## Abstract

*This paper explores the views of intelligence held by two groups of students studying for the degree of Bachelor of Technology Education (B.Tech.Ed) at a Scottish University. The course is specifically designed to educate students for a career as teachers of technical education in secondary schools. The research builds upon the work carried out by Carol Dweck on implicit theories. Dweck (Dweck and Legge, 1998) postulates that two views of intelligence are held which she labels entity and incremental. The entity view assumes that intelligence is stable and global. Incremental views on the other hand are based on the assumption that intelligence is malleable and can change over time and according to context. The theories that are held by individuals have important implications for teachers through determining the type of learning structures they create. Analysis of the two groups indicates some important differences between them. These are explored and the implications of the findings are discussed*

## Keywords

*implicit theories, intelligence, learning goals*

## Introduction

Implicit beliefs or meaning systems are used to organise and interpret experience (Sternberg, 1990; Dweck, 1996). In terms of the construct of intelligence, two implicit views are postulated which may be labelled 'entity' and 'incremental' (Dweck and Leggett, 1988). Those holding an implicit entity theory of intelligence will regard it as a stable and global phenomenon. Conversely, those who adhere to an implicit incremental theory will assume that intelligence is malleable and subject to change over time and according to context. An extensive body of research suggests, moreover, that the particular theory held will have important implications for teachers in relation to classroom practice. For example, as Sternberg suggests:

'Understanding people's implicit theories is important because it is these theories that motivate people in their everyday judgements of the intelligence of others.'

(Sternberg, 1990: 67)

Since this will clearly have an important impact upon the learning of pupils, it was decided to explore these views in student teachers and to consider the potential implications for the initial teacher education course.

## Methodology

First and fourth year students on the Bachelor of Technology Education Course (B.Tech.Ed) course were issued with questionnaires devised by Carol Dweck (Dweck, 1999). The questionnaires are designed to explore the implicit theories which people hold regarding the nature of intelligence. Two forms of questionnaire are available. One scale explores people's views of their own intelligence. In this case, since the assumptions made about the intelligence of others will have important ramifications for future teachers, the 'others' scale, designed to predict the judgements which people make about the intelligence of others, was used. The questionnaire comprises eight statements which invite agreement on a six-point Likert scale ranging from one (strongly agree) to six (strongly disagree). Entity theorists are more likely to agree with statements such as 'People have a certain amount of intelligence and they can't really do much to change it' and to disagree with statements such as 'People can substantially change how intelligent they are'. Incremental theorists are more

likely to show the opposite pattern of agreement and disagreement with the statements. Test-retest validity for the scale has been found to be .64 ( $p < .01$ ) (Erdley and Dweck, 1993). Respondents were also asked to give details about gender, age ethnicity and the number of years spent working outside the education system prior to entry to university. An open question was included which was designed to obtain richer data about students' understanding of the construct of 'intelligence'.

33 questionnaires were completed by students in the first year of the course and 11 were completed by fourth year students. This represents 92% and 73% of the year groups respectively. Two scores were obtained for each student from responses to the entity and incremental items. A score of 24 on entity items indicated a high level of disagreement with these items, whilst a score of four indicated a high level of agreement. A score of four for incremental items, on the other hand, indicated a high level of agreement with these statements and a score of 24 on incremental items indicated a high level of disagreement with these. Thus a high score on entity items and a low score on incremental items suggest a strongly held incremental theory of intelligence, whilst a low score on entity items and a high score on incremental items suggest a strongly held entity theory. A score of above 12 on the entity items and under 12 on the incremental items were taken to indicate a moderately held incremental theory, whilst scores of under 12 on the entity items and over 12 on the incremental items were indicative of a moderately held entity theory.

### Results

Initial analysis of the data revealed that only two students from the entire sample held particularly strong incremental theories of intelligence as measured by the scale, scores of 24 each on the entity items and four and five respectively on the incremental items. Both students were on the first year of the course. There were no correspondingly high entity scores. Although scores of 20 and 22 were registered on incremental items by two students, these did not demonstrate correspondingly low scores on the entity items with scores of 11 and 14 being obtained. In this case, the students were from first year and fourth year respectively.

Using the criteria previously outlined, 48% of the first year students were judged to hold relatively strong incremental theories, compared to 27% of the fourth year students. In addition, 12% of the students from the first year indicated fairly strong disagreement with incremental items (scores of 16 and above) compared to 60% of the fourth years.

Further analysis indicated no effect of age, gender, ethnicity or the number of years spent outside the education system. Whilst independent samples t-tests indicated that the mean differences in respect to entity theories held by the two groups were not significant, differences in incremental theories did reach significant levels. In this case, significantly more students in the first year of the course were found to hold incremental views of intelligence than students in the final year. This suggests that, although the small numbers involved in the research means that the results must be interpreted with caution, there may nevertheless be some important differences between the two that are not simply the result of chance.

Responses to the open questions were analysed according to Sternberg's (1986) collection of contemporary views of psychologists. The purpose of this was threefold. One was to explore the extent to which there was a correspondence between experts and laypersons. Sternberg, for example, suggests that an important distinction between explicit and implicit theories can be made. Whilst explicit theories of intelligence are constructs devised by psychologists, based on data derived from analysis of performance on tasks constructed to (presumably) measure intellectual functioning, implicit theories are informal constructs which already exist, not necessarily as definitions, within the mind. Thus it is perfectly possible for explicit views and implicit views to conflict.

A second purpose was to compare the types of definitions of intelligence given by the two groups of students and the third was to identify any significant differences in definitions of intelligence between those holding entity and incremental theories. Here again, interesting differences emerged.

Although a wide range of factors were identified by the psychologists, the aspects identified most frequently were: higher level components, such as abstract reasoning, representation, problem solving and decision making (50%), that which is valued by culture (29%) and executive processes (25%).

The aspects identified most frequently by students were understanding (43%), ability to learn new skills (39%) and knowledge (26%). Unlike the experts, only one student considered cultural factors: 'society's interpretation of how clever or not a person is' and two mentioned higher-level components of problem solving and decision making. It is interesting to note that, whereas the main emphasis of the experts was on higher order skills, with the students the focus was on the lowest levels of Bloom's (1956) taxonomy of

learning. Perhaps significantly, these are also the types of learning assessed in the Scottish Standard Grade examinations.

However, some interesting differences between the two student groups also emerged. For example, whilst 49% of the first year group mentioned understanding, this was identified by only 27% of the fourth years. Similarly, whilst knowledge was mentioned by 43% of the first year group, only one student in the fourth year identified knowledge as a component of intelligence. Fourth year students were more likely to emphasise the ability to learn (45%) or to plan, change or understand (45%).

Interestingly, intelligence was slightly less likely to be equated by fourth year students to practical work or the acquisition of practical skills with 24% identifying these aspects compared to 18% of fourth years.

In relation to entity and incremental views, interestingly, there were very few clear distinctions between those identified as entity or incremental theorists with only two students identified as having a clear entity view defining intelligence as ‘something you are born with’ and ‘inherited.’ Both these students were on the fourth year of the course.

A number of students appeared to demonstrate a degree of ambiguity, emerging with no clear entity or incremental scores. Thus one student with a score of 14 and 15 on the two scales suggested that there was ‘a potential to increase intelligence and understanding only to a ceiling level. Some people are naturally intelligent – also upbringing’. Another with scores of 18 and 15 suggested that intelligence ‘is either gained naturally or gained to learn knowledge’. Another noted that ‘you can be well educated but not very intelligent and very intelligent but not well educated. Intelligence is completely different from education.’

### Discussion of results

Since people generally tend to hold fairly strong views on the nature of intelligence, the existence of ambiguous scores is unexpected. There are several explanations which may account for this.

One explanation is that some of the students are genuinely uncertain about their feelings about the nature of intelligence. Thus, although the entity and incremental items seemed to contradict each other, they saw no ambiguity in agreeing or disagreeing equally with both.

Another, and perhaps more likely, explanation is that this seeming ambiguity is a function of the methodology. Hong *et al* (1999), for example, note that

pilot studies using Dweck’s scales have shown that:

‘even for respondents who endorse items depicting entity theories, there is a strong tendency to endorse items depicting the opposite incremental theory, as well as a tendency to drift towards incremental choices over time.’

(1999: 590)

This would also help explain the lack of distinction between entity and incremental theorists in their responses to the open question asking for a definition of intelligence.

It also, however, suggests that the implicit theories held by the respondents may, in reality, be even more oriented towards entity views than analysis of the data would at first suggest.

Another explanation might be impression management. Students on a course related to teacher education can be expected to have knowledge of current theories of intelligence and where these are in conflict with their own implicit theories, there may be a tendency to endorse items which they feel they might be expected to express, as well as those in which they really believe.

This, however, does not explain the surprising differences between the first and fourth year groups. Less than half of the first year cohort and only 27% of the fourth year cohort appeared to hold implicit views that were even moderately incremental. The potential implications of this for future classroom practice can be demonstrated by a consideration of some research in the area.

Molden and Dweck (2000), for example, emphasise the role of implicit theories of intelligence in eliciting particular types of goals. Teachers who hold entity views of intelligence are more likely to create structures within their classroom which emphasise what Dweck (1999) terms ‘performance’ goals. When performance goal structures are created, the focus is on ability and self-worth. Effort by pupils is expended on attempts to appear competent and the avoidance of appearing incompetent. The product of learning, rather than the process, becomes important. Failure is attributed to lack of ability and difficult tasks are regarded as a threat. Risk taking and challenge, so central to the design process, are avoided. Pupils are less likely to persist in the face of difficulty with the result that superficial learning occurs. Significantly, it is not only the pupils who are regarded (or who regard themselves) as less able who are disadvantaged in this situation. In classrooms where ability is equated with performance, more able pupils are

equally affected by the fear of failure since each new task becomes a challenge to their perceived innate ability. As a consequence, easy tasks, which will pose no threat to status, are selected over challenging tasks, which would more effectively advance learning.

Those who hold incremental theories, on the other hand, are more likely to create structures where the focus is on learning goals. Here, the actual processes of learning become more important than the product. The main purpose of learning is perceived as the development of skills. When difficulty occurs, it is regarded as a normal stage of skill development. Failure is perceived as an important aspect of learning rather than a function of global ability and therefore poses no threat to feelings of self-worth. Skills are regarded as abilities which develop gradually over time. Success is attributed, not to ability, over which there is no control, but to effort, over which there is total control. Difficult tasks represent a challenge to be welcomed and tasks which are regarded as easy are eschewed as detrimental to progress. Pupils working within this framework are likely to spend more time on task, to demonstrate greater persistence in the face of difficulty, to develop a range of strategies which will facilitate future success and to achieve deeper and more meaningful learning.

In addition, Ames (1992) identifies three aspects of importance to the structure of learning environments conducive to the adoption of learning goals. These are task design, evaluation and the distribution of authority.

Tasks which are meaningful to the student, which encourage effort and active involvement and where there is diversity and variety are, according to Ames, more likely to result in the adoption of learning goals. Tasks in which the focus is on the process, such as the development or understanding of new skills rather than the product, will also reduce the emphasis on performance.

Diversity of task, moreover, reduces the likelihood of social comparison with the consequence that differences in performance are less likely to result in perceptions of differences in ability among pupils.

In relation to evaluation, Ames stresses that a focus on marks or grades and the public display of progress charts or displays of best work encourages social comparison and has a detrimental effect on motivation and the consequent selection of future goals.

Controlling environments with the emphasis on rewards and other incentives are also regarded as conducive to the adoption of performance goals. In

classrooms where independent thinking and autonomy is encouraged, where students enjoy a sense of challenge and personal control, the adoption of learning goals is more likely to occur.

There are also important implications in terms of the differing effects of praise. When praise is directed at ability or intelligence, the effect is to generate a system supportive of entity views. Praise directed at effort on the other hand is likely to generate a system synonymous with incremental views (Mueller and Dweck, 1998).

The impact of differences in implicit views of teachers, therefore, may be an important factor in the type of learning environment they create within a design and technology setting. Whether the emphasis in teaching and evaluation is on the end product or on the development of the skills and processes in its manufacture; whether feedback, praise and displays of work place emphasis on effort or social comparison; whether prescriptive whole class teaching or autonomy and variety are utilised will all influence the meaning that pupils take from failure and their response to risk-taking and challenge in an area where innovation and creativity are essential.

The fact that the first year group had a higher proportion of implicit incremental theorists than the fourth year group may also have important implications for the initial teacher education course.

Although the small numbers involved mean the results must be treated with caution, if this is not a result of chance or the result of inherent individual differences between the two groups, the possibility exists that during the course of the degree, students for some reason are more likely to develop an entity view of intelligence. At any rate, it seems clear that the course does not have a strong influence on producing students with incremental views.

One reason may be that implicit views are in some way resistant to change, although research by Bergen, cited in Dweck (1999), suggests that implicit theories may at least be temporarily altered. The potential for change and the implications of this for the course are important areas for future research

Whether or not these do prove resistant to change, it is important that students on initial teacher education courses should be made fully aware of the potential impact of implicit theories on their classroom practice. Findings from this study and experience from tutors who carry out school visits suggest that this is not the case. It is clearly not enough for initial teacher education courses to debate intelligence alone.

It is necessary also to encourage students to make their views explicit, to address areas of ambiguity and to help them explore the different types of learning environments that teachers can, perhaps unwittingly, create.

Technology education is an area where there are excellent opportunities to develop higher order skills, such as problem solving and decision making. If the focus of teachers is on the lower order skills of knowledge and understanding and on end-products rather than processes, then valuable opportunities to develop real learning experiences within the area of technology will be lost.

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