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CASE STUDY

Motivating Mature Students of Mathematics

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Abstract

This paper considers mature students who take a pre-degree Certificate in Science at a university in Ireland. In particular, it focuses on typical challenges that these students face in their mathematics education, and discusses some motivational techniques their lecturer used in an attempt to address student concerns. It situates these techniques within the general theory and considers how to measure their impact.

Keywords: Mature Student, Motivation

1. Introduction

Every year, Maynooth University admits 15-25 students to The Certificate in Science Programme (the Certificate). This one-year course is designed for mature students returning to education. For the purposes of this course, a mature student is classified as anybody over 22 years of age, on the first of January in the year they commence the course. These students typically would not meet the entry requirements for a place on a degree programme and would be recommended to complete the Certificate. Provided the student achieves a specific overall grade in the Certificate, a place would be offered to them on a degree level programme in Maynooth University.

Students begin the course in mid-September with a proficiency examination to gauge their general mathematical ability. It tests basic mathematics such as sets, arithmetic, algebra and trigonometry. The median grade was 35% for the 2014-15 class group, and 33.5% for the following year group.

Early in both years, students communicated to the course lecturer (first author) regarding their previous negative experiences in education. In particular, they focused on mathematics, and their concern that it was a barrier to their progression to their degree of choice. Based on this information, the lecturer, who had taken a Psychology of Education module during his teacher training, decided to draw on this knowledge in an attempt to motivate the group and encourage them to keep the required momentum to pass the module.

This paper considers the three most frequent scenarios related to student motivation which were encountered in these classes. We examine some prominent theories of motivation and discuss how they were implemented in the classroom. We close with an analysis of the quantitative and qualitative data available from both groups in an attempt to determine what effect, if any, the strategies implemented had on student motivation.

2. Literature Review

Motivation may be defined as "…a force that energizes and directs behaviour toward a goal" (Eggen & Kauchak, 1994: p.427) and is often categorised as either extrinsic or intrinsic (Merriam & Bierema, 2013). Extrinsic motivation is "…motivation that occurs from reinforcers, feedback, or rewards that are not inherent in the activity itself" (Good & Brophy, 1995: p.402). The person is often not interested in the task, but rather is concerned with what they can gain by doing it. On the other hand, intrinsic motivation is an individual's own natural tendency to want to seek out solutions to problems. "The "reward" for engaging with the task lies in the pleasure and sense of satisfaction that are inherent in engagement itself" (Anderman & Anderman, 2010: p.30). We should nurture intrinsic drive in our pupils; however this can also be supported by extrinsic influences. We will now examine different approaches to extrinsic and intrinsic motivation and consider how they complement each other.

Behavioural approaches to motivation (extrinsic) are centred on the ideas of positive and negative reinforcement. From an educational perspective, the aim is to encourage a particular behaviour or attitude in students using these reinforcers. The idea is that "All of the infinite variety of human behaviour can be made more or less frequent or probable by the use or non-use of reinforcement, contingent on some response" (Gage & Berliner, 1992: p.231).

There are a number of common methods used in the classroom to bring about behavioural modification. Sometimes we offer simple rewards or punishments/sanctions in order to promote hard work or good behaviour. In particular, praise (Biehler & Snowman, 1997) and constructive feedback can be a powerful tool in encouraging students to work. This recognition can make a pupil feel good about themselves and encourage them to keep working and engaging in class. The quality of feedback that students receive impacts their self-confidence (Capel & Gervis, 2005).

Some researchers argue that the use of reinforcers can negatively impact on the intrinsic motivation to learn (Eggen & Kauchak, 1994) and the student is simply trying to impress a teacher rather than having a desire to solve a problem. However, Jordan et al (2008: p.34) argue that "Behaviourism is not totally antagonistic to other theories of learning; rather it can co-exist with later learning theories that focus on cognition or the social acquisition of meaning."

Social approaches to motivation (extrinsic) are concerned with the impact on motivation that may be obtained from the social interactions of students with their teachers, peers, etc. The teacher should be an individual who is "…warm, understanding, friendly, responsible, systematic, imaginative and enthusiastic…" (Fontana, 1995: p.384). Indeed "A student who identifies with and admires a teacher of a particular subject may work hard partly to please the admired individual and partly to try becoming like that individual" (Biehler & Snowman, 1997: p.400). For this reason, the educator should aim to foster a mutual respect between the students and teacher in order to create an environment where learning can take place.

Peers are another key social motivator in the learning experience. It is natural that an individual finds a social group that shares similar thoughts, opinions and beliefs as themselves. "Students learn together in class, while friends, classmates and study partners learn together outside of college campus" (Lei, 2010: p.156). If the peer group places a high value on academic success then it is likely that the individual will aim to conform to this

ethos. These social groups can have a positive effect on an individual as they can be a wonderful source of intellectual as well as emotional support.

The humanistic approach to motivation (intrinsic) "stresses students' capacity for personal growth, freedom to choose their destiny, and positive qualities" (Santrock, 2009: p.461). One key ingredient of this humanistic approach is the development of self-efficacy. "In general, self-efficacy is a person's self-constructed judgement about his or her ability to execute certain behaviours or reach certain goals" (Ormrod, 2008: p.356). The psychologist Albert Bandura identified the following four factors that affect self-efficacy:

Mastery Experience:

"Successes build a robust belief in one's personal efficacy" (Bandura, 1998: p.624). If a pupil has previously succeeded in a similar task or subject area, they are more inclined to approach new material with a degree of enthusiasm and confidence. It is important that challenges posed to students are appropriate for their learning level. If the task is too simple, while the student may receive an immediate increase in self-efficacy, it will not teach them perseverance for more difficult problems or situations.

Vicarious Experiences:

Bandura (1998: p.626) states that "Seeing people similar to oneself succeed by sustained effort raises observers' beliefs that they too possess the capabilities to master comparable activities to succeed." For example, if a pupil has reservations about whether or not they can solve a mathematics problem, one might reassure them by illustrating how students in the past have had similar concerns but were in fact successful at completing the task.

Verbal Persuasion:

Bandura (1998: p.626) explains that "People who are persuaded verbally that they possess the capabilities to master given activities are likely to mobilize greater effort and sustain it than if they harbour self-doubts and dwell on personal deficiencies when problems arise." Praise can boost a student's self-efficacy and contribute to that internal feeling that they can succeed. Educators must make a conscious effort to explicitly identify, for the sake of the pupil, how they have excelled in a particular area, be it an academic subject or an extra-curricular activity. Goals set by both the educator and the student must be achievable.

Physiological State:

How a human interprets their physiological reactions to situations, determines whether they get a boost to their self-efficacy or not. For example, as part of a project, a student may have to give a class presentation. Some pupils may have feelings of anxiety around facing their classmates. "They interpret their stress reactions and tension as signs of inefficacy" (Bandura, 1998: p.626). Depending on the learner's level of self-confidence, they may either embrace the challenge or shy away from the task. It is therefore vital that teachers do all in their power to control situations like this to ensure a positive outcome.

The cognitive approach is another intrinsic source of motivation. From this viewpoint, people are seen as having a desire to seek out solutions to problems. They have a natural curiosity and when a topic is personally relevant, they require little incentive to pursue an answer. It is important that the teacher, when planning a lesson, makes the material as relevant as

possible for the students. With reference to mature students, Knowles (2012: p.257) argues that we should "…use the existing knowledge experience and motivation of learners to shape the learning experience."

One approach is to use inquiry based learning. "Inquiry-based education is a learner-centered form of teaching and learning that enables students to tailor at least some of their learning experiences to their own interests and curiosity" (Saunders et al, 2012: p.17). The teacher assumes the role of a facilitator rather than a source of information and the class can be divided into groups because

> …the shared responsibility and interaction produce more positive feelings toward tasks and others, generate better intergroup relations and result in better self images for students with histories of poor achievement (Joyce et al, 1997: p.89).

This approach encourages the pupils to ponder higher order questions and not shy away from challenges.

3. Common Scenarios

Each year, common scenarios relating to student motivation occurred on a regular basis. The lecturer observed that members of the class who presented with these scenarios could be loosely categorised into three groups. It should be noted that some students fell into more than one category. We briefly describe these scenarios for the academic years 2014-15 and 2015-16 and we provide detail on the various techniques employed, in an attempt to address the issues raised. These methods were implemented during every lecture (6 per week).

3.1 Students with Mathematical/Educational Baggage

Students in this category (approximately two thirds of the class in both years) were asking questions, working in groups and regularly availing of the optional extra supports available in the Mathematics Support Centre (MSC). The lecturer noticed early on in the module, that these students had negative knee-jerk reactions to new material presented in lectures. Often these occurred before the students had engaged with or even read the material in question. Remarks such as "this is really difficult" or "I'm never going to get this" were frequently heard aloud in class. While these students were not necessarily at risk of failing, the concern was that this mentality would snowball and impact on the atmosphere of learning for all students within the class. In an attempt to counteract this, the lecturer implemented a number of motivational strategies, principally using vicarious and cognitive approaches.

Prior to new material being presented in class, the teacher would remind the group that it is normal for new material to seem difficult when seen for the first time. Vicarious approaches (Bandura, 1998), such as informing the class that previous groups who had taken the same module had similar initial reactions. However, when they engaged with the material, they realised that it was not as difficult as it first appeared. In addition, class tours of the National Science Museum and the University's Russell Library were organised. This library houses a significant collection of old mathematical texts. These tours included brief presentations on the items being displayed, which demonstrated to the students that the study of mathematics and science is a process that takes time and patience.

Cognitive approaches, as outlined by Knowles (2012), were also used by the lecturer in lesson planning. Problems were chosen which appealed to mature students' experiences

and natural curiosity and they were encouraged to work in groups to bring them to a conclusion. For example, when working on basic statistics, the class considered current economic issues, the relevant data, and how they were presented in the media.

3.2 Students with External Concerns

Students placed in this category (approximately one quarter of the class in both years) had informed the lecturer, in one-to-one conversations, that they felt under pressure balancing their studies and their personal lives, e.g. many students had part-time jobs, young children etc. Typically these students did not have serious difficulties with the mathematics in the module; they were engaging and actively working, but the lecturer was concerned that they might drop out due to their external concerns.

Students would often confide that they were doing this course in an effort to improve their employment prospects, while others did not have the opportunity to go to college in the past and doing this course, was to some degree, fulfilling a dream of theirs. In either case, these behavioural motivators (Gage & Berliner, 1992) were used to remind them that this short term pain, effort and stress could ultimately lead to them realising their goals. They were reminded of the educational supports available to them and that social motivation (Lei, 2010) should be sought from their classmates as many of them were in similar situations.

Time management issues were also exacerbating the problem for some students. In these circumstances, the lecturer made suggestions to help ease the student's burden, e.g. scale down on volunteer activities in the local community. Most students took this feedback on board, due in large part to the lecturer's advice to reflect on the motivators that drove them to return to education. Students indicated that this had helped put their priorities in perspective. The effect of these conversations was almost immediate and the lecturer witnessed a significant improvement in their demeanour.

3.3 Passive Students

These students were attending the majority of their classes and doing their assignments but were considered "passive" by the lecturer (approximately one quarter of the class in both years). They were not asking questions in class, often working on their own and were not attending the MSC. The lecturer was concerned that these students were doing the minimum they thought was necessary to get by, while it was clear to him that they would fail if their behaviour continued.

In these cases, they lecturer spoke to the individuals in private. He voiced his concerns in an effort to gain insight into why they were approaching their studies in this manner. In most cases the student simply did not know how to study or were unaware of the effort that was required to be successful. In these situations, they were advised to join one of the study groups that were developing in the class. Students in these groups not only worked together in class, but also studied together in the MSC and outside of the university (Lei, 2010). In this way, it was hoped that they would come to realise that their previous work rate was not up to par. They were verbally persuaded (Bandura, 1998) by the lecturer that there was time to turn it all around and still pass the course.

4. Results

As both academic years progressed, there were clear indicators that most members of the class appeared, to the lecturer, to be more motivated. For example, the frequency of negative comments on the difficulty of material reduced considerably, classes were rarely missed due to external commitments, and students were observed working together on a regular basis.

Unfortunately, a small number of individuals, mostly in the 'Passive Student' category, did not change their approach, and many of these failed to progress from the Certificate. However, based on these classroom observations alone, it is impossible to state categorically that student progress or non-progress was as a result of the lecturer's various interventions. We now attempt to measure student progress with the available qualitative and quantitative data.

At the end of the two academic years, students filled in an anonymous course evaluation form. There were a total of 18 questions, and 33 students completed the questionnaire. The feedback in general was extremely positive. Two questions are particularly relevant to this paper:

Q: "Having taken this module, do you feel your mathematical knowledge and confidence has improved? In what way?"

Thirty students answered this question, and they all had positive responses. Samples include:

> "Yes, I literally knew nothing about maths coming in, now I'm not as scared of it anymore and have a genuine interest in it."
>
> "My knowledge and confidence has improved so much that it has had a positive impact on my life outside of college too. It has given me more opportunities for a better, successful future."

Q: "Having completed this course, do you feel prepared for future studies in mathematics or other science based subjects?"

There were 31 responses, all were positive in nature. Samples include:

> "I am more prepared and confident with moving on in a science degree"
>
> "Yes, I feel this course has set me up for the future."

There was limited quantitative data available for analysis. In 2015, Maynooth University Access Office (MAP) (O'Neill & Fitzsimons, to appear) commissioned a report, which detailed various facts and figures for the Certificate for the years 2002-2012. This report included the completion rates for students (n=153) that registered for the Certificate during those years. The results are reproduced in Figure 1.

When we look at the figures for 2014-15 and 2015-16, we see that completion rates of 73% and 86% in 2014-15 and 2015-16 respectively compare favourably with the completion rate of 64% for the years 2002-2012. Completion rates in the individual subjects for the Certificate are not available.

The MAP (O'Neill & Fitzpatrick, to appear) report also considered when Certificate students that progressed to degree studies in Maynooth University were most likely to drop out. It identified non-progression to second year as most common, with an average drop-out rate of 25% for 2002-2012. At the time of writing, we have data for the 2014-15 students only. We found that of the 14 students that progressed to the 1st year of degree studies, 3 failed to progress, which translates to a marginally better rate of 21%.

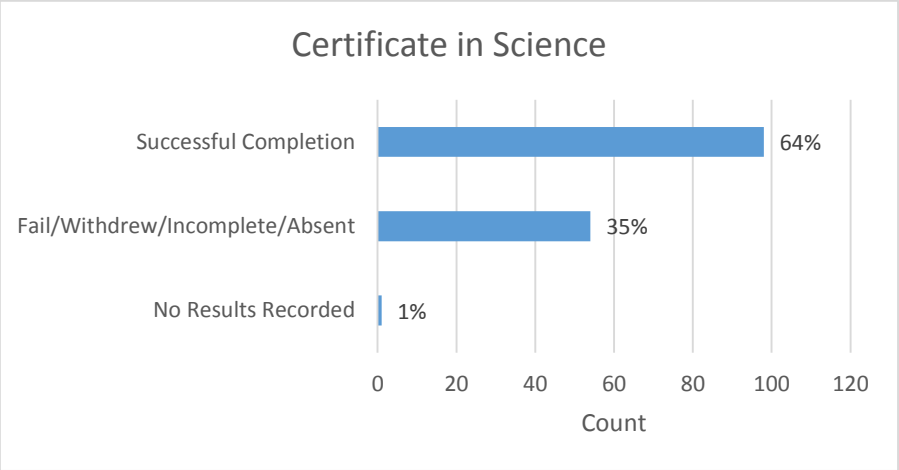

Figure 1. Completion Rates (n=153) for 2002-2012.

5. Conclusion

It is extremely difficult to get a measure of how the implementation of the theories outlined above affected the students. The qualitative data (anecdotal evidence and student feedback) and some of the quantitative data are encouraging. However, the data does not provide sufficient evidence to conclude that the strategies described in this paper were the sole reason for any improvement in student motivation.

Jordan et al. (2008: p.137) reminds us "that adults learn in a different way to children and will use different learning techniques that require different teaching strategies." For this reason, in conjunction with the results of our research, we believe that teachers should be mindful of some theories of motivation, as they can have a positive impact on mature students and help sustain them in their studies.

It is clear that quantitative data alone does not necessarily capture an individual's level of motivation. For example, interviewing students would give additional insight into any changes of attitude or enthusiasm. The data and anecdotal evidence presented suggest that a detailed study with more in-depth analysis would be worthwhile to determine if these results could be repeated on a broader and more sustainable basis.

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