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Promoting inclusive practice in mathematics and statistics

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Editorial

Sincere thanks to Dr John Conway for guest editing issue 4.1 of The Journal of Inclusive Practice in Further and Higher Education. I am delighted that the journal is continuing to develop while remaining true to its principles (which are reflected in the Editorial Guidelines which appear at the end of every edition). Feedback is always welcome and The Editorial Board is particularly keen to know how the new electronic presentation is received by the readership. As NADP members are increasingly taking up the opportunity to work towards Accredited Member status, the Editorial Board anticipate a renewed enthusiasm for writing for the journal. Splitting contributions into refereed and non referred categories may make potential contributors feel more confident about submitting and it would be interesting to receive views on this innovation. Thanks of course also go to reviewers and authors. Happy reading.

Dr Nicola Martin. Editor.

This latest edition of JIPFHE was intended to focus on disabled students' experience of STEM subjects and includes two papers on maths. Several other papers were offered around dyslexia and related SpLDs and it's interesting to consider Pat Mulcahy's propositions around integrating AT and dyslexia study skills.

NADP has decided to move toward electronic publishing both to improve accessibility and to reduce our environmental footprint. This edition is the first to be available only electronically. Members will be able to access it from the members' area of the website in advance of it going on general release.

As we go to publication, news has broken of the Disability Standard awards managed by the Employers' Forum on Disability where two key supporters of disabled students figure in the top 10; Microlink at number 1, Iansyst at number 4. Microlink is also named the best SME and its CEO and co-founder, Dr Nasser Siabi is named as a Disability Champion. NADP would like to extend its congratulations to both companies, and to Nasser who commented:

> " I am very proud that our industry is playing on the bigger stage to drive forward the disability inclusion agenda. There is tremendous potential for those involved in the DSA market to lead on innovations and export their expertise to the rest of the world.
> All the good work we have been doing for the employment sector is built on our experience gained from many years of working in the DSA market. We

must preserve this great scheme and have promote it to other countries as a great beacon of success.

It is vital to have a joined up service for people with disabilities to live and work in the society. Therefore it is important that students with disabilities leaving education receive the same level of support in work place as they did during their studies, hence we are working with SLC and DWP to make this becomes a reality soon".

Ian Litterick, iansyst Executive Chairman, said

"We are very pleased that two comparatively small DSA assistive technology providers were able to rate at the top with many of the country's biggest and best resourced organisations. Being involved with the DSA and all its stakeholders helps to ingrain disability consciousness, keeps us learning and helped us to reach no 4 at our first attempt at the Disability Standard. It's great to have recognition where we try to achieve excellence."

Full details of the criteria and the awards can be found on the website...

https://www.disabilitystandard.com/awards/2012-awards/

Dr John Conway,

Guest Editor.

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Promoting Inclusive practice in mathematics and statistics

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Abstract

This article describes a teaching approach designed by the author to maximise student participation and enhance students' learning experience in undergraduate mathematics and statistics service courses.

The author's aim is to effectively address issues arising from neurodiversity identified with students' specific learning differences that are possibly manifestations of their negative attitudes towards mathematics and statistics. These differences influence the student's abilities to learn in normal learning environments by conventional methods and may be either because of previous unpleasant experiences of engaging with the subjects or other contributory factors such as specific learning differences. Further, based upon the author's experience described in the article, it is proposed that students who identify with Asperger Syndrome may benefit from her approach.

This article reports on the author's approach that positively contributed towards improving students' perceptions of mathematics and statistics. Further, it enhanced student engagement, their academic self-efficacy, promoted student participation and created interest in the subjects.

Background and issues

The author is involved with teaching mathematics and statistics courses to undergraduates on a variety of degree programs such as Actuarial Science, Econometrics & Mathematical Economics, Accounting & Finance and Management Sciences.

As a result of this variety, students have different expectations of these courses. Students are from a variety of cultural backgrounds which influence their preferences for teaching approaches and learning styles they feel comfortable with. Students'

individual learning requirements, as a result of their wide ranging academic backgrounds, must be appropriately addressed. Further, students' poor perceptions and negative preconceived notions of the subjects need to be carefully addressed as these two factors obstruct the engagement and learning process of students as observed by the author.

Finally, students with learning difficulties may experience discrimination due to attitudinal barriers in education which can be removed by changing the teaching approach and designing class activities to promote participation. The author's teaching approach aims to remove such barriers so that disabled students are not at any disadvantage in the learning environment (Hornstra, Denessen, Voeten, van den Bergh, & Bakker, 2010)

The main hypothesis

A student centred teaching approach (SCTA) will enhance student engagement and participation taking in to account students' diverse academic and cultural backgrounds and/or learning differences.

The two related research questions about such an approach are:

1. Would a SCTA promote inclusive teaching practice in mathematics and statistics?
2. Would a SCTA enhance students' confidence and positively contribute to their academic self-efficacy?

Methodology

The author's teaching approach is developed, reviewed, revised and modified based upon the outcome of an open ended informal questionnaire e-mailed to all (175-200) students two weeks after teaching commences as below:

1. What aspects of my teaching help you engage and learn in my classes?
2. What prevents you from learning?
3. What would you change or modify about my teaching?

Further, the author is perceptive to students' spontaneous feedback which is highly valued because it is unprompted and often provides relevant information. This is compiled by storing data of students' comments during office hours and students' unprompted emails reflecting useful feedback.

Key points

A variety of learning and teaching activities in this approach are used to

1. Kindle students' interest in mathematics and statistics
2. Enhance students' learning experience in lectures and classes
3. Widen student participation and promote interaction
4. Improve students' perceptions of the subjects
5. Act as a facilitator and a guide to students

The approach

The approach discussed below is developed with the aim of effectively addressing the variety of learning requirements of students and improving their perceptions of the subjects. This is done by using carefully designed formative assessments, providing constructive feedback, and promoting interaction in lectures and classes. Further, the author designs lectures and classes to help students overcome their anxiety as a result of negative pre-conceived notions about the subjects.

A short formative assessment question or a multiple choice question (MCQ) based on key ideas in previously covered material is used to begin classes. It is important to diminish test anxiety (Benson 1989) which is done by assuring students that the purpose of the question is to facilitate learning and not to test them. The answer is displayed with a brief explanation after two to three minutes. Students' comments show that this helps students to link new concepts with their existing knowledge. "The richer the links between new and existing information, the deeper the knowledge and the more readily it can be retrieved and applied in new situations" (Zull 2002). Students' confidence is enhanced either because they arrive at the correct answer or because they learn something from the displayed solution. This facilitates interaction, creates interest, makes students receptive to the rest of the class content and positively contributes to the learning climate. The author ensures that students' participation is acknowledged by encouraging comments and positive statements on students' contributions in general without referring to those who get the correct answer. This can make a difference to their participation with future class activities and also ensures that they view it positively. Constructive comments on students' performance continue to enhance their interaction and perceptions of mathematics and statistics. A similar approach is successfully used by the author in

lectures to large groups of 300 or more students repeating the process at least twice. This enhanced interaction in lectures as observed by the author and improved students' attendance as shown by attendance records. It can make lectures more interesting, lively, engaging and interactive.

"A well planned thoroughly prepared lecture could be forgotten once the lecture is finished. It is important for lecturers to create an atmosphere that is conducive not only to the free exchange and expression of ideas but also to promote further curiosity in the subject. It is equally important to be empathetic to those that believe they lack the aptitude for Mathematics. It is crucial for the lecturer to make a conscious effort not to allow the complexity of the subject to overwhelm the audience" (Kotecha, M. 2010a).

Students who have low confidence due to any reason find this experience extremely exciting and begin to feel confident to engage with the subjects as demonstrated by the students' increased interaction with the author as well as their peers. Their comments reflect how their confidence grows as they continue to participate and get correct answers, which gives them the sense of achieving something they previously viewed as inaccessible.

Short questions and MCQs are also useful for diagnostic purposes to gauge their knowledge and grasp of concepts covered. This process helps assess a variety of learning outcomes and identifies problem areas and individual learning requirements that need to be addressed, enabling teaching to be suited to their requirements.

Application questions are used in classes and students are advised to work in groups under the author's guidance in a workshop setting. The author circulates playing the role of a facilitator guiding students as they engage with group work and seeing students individually if they are working on their own. These questions are carefully designed and set on themes students can relate to and view as "fun" questions (Kotecha, M. 2011b) which positively contribute to their engagement. "Our students need practice with manipulating information to solve problems...we require creative thinking in order to solve new and unusual problems that demand new and unusual solutions" (Ebert and Ebert, 1998).

Students from certain Asian countries usually show a strong preference for teacher centred styles of learning probably because they are used to a system that lack student-centred learning activities (Chan, 1999 and ICME 2012). Such students initially show a preference to work on their own, which may be due to their cultural

background influencing their views on the teacher's role. There are several other reasons such as diversity in learning style preferences and past learning experiences that could prevent students from participating in group work. Students usually, after about two to three classes, learn to be active participants, make meaningful contributions and are not only happy with the teacher acting as a facilitator but also benefit from it. This is demonstrated by their improved engagement in classes. This enhances student participation, promotes discussions and facilitates deep learning as they engage with discussions about their approach to these questions. Further, group work helps them develop interpersonal skills, effective communication, team working, and the ability to effectively contribute to discussions. It promotes creative/reflective approaches to problem solving and contributes to active learning. Students who may identify with Asperger Syndrome (AS) are unlikely to get used to group work and require teacher's assistance with such activities. Students with AS often find it difficult to follow instructions such as "Work with the student seating next to you" or "Get in to groups". They need to be assigned specific tasks and prefer structured learning activities, which applies even to a brain storming session (Young, R. 2008).

The workshop setting makes it possible for the author to circulate and see students individually to identify their strengths, specific learning requirements, concerns and anxieties. This is because it enables the author to talk to students in an informal setting which puts students at ease creating opportunities to share their concerns with the author. A minority of students may take a bit longer to relax, but they soon get involved and contribute to group work and make excellent use of this opportunity. They find it easier to share their course related queries and anxieties with the author without becoming self-conscious in the presence of their peers. It helps the author to effectively address individual requirements of these students and provide them with appropriate support and guidance by advising them to use her office hours.

The author argues that students who identify with AS may benefit from the opportunity to receive help and attention on a one to one basis in a class setting. The author is able to provide students with constructive feedback, step by step instructions, guidance and support as required. The author is able to give students individual attention during the workshop session and remind students of their strengths which positively contributes to boosting their confidence. Danny's case included in this article briefly describes how he/she benefited from the author's

approach. Danny signed a disability disclosure agreement and his/her real name is not used in order to preserve his/her confidentiality. Further, all students whose comments are included in this article are informed at the outset that their feedback/comments may be used for academic related purposes.

Students enjoy working on the author's application questions and begin to view mathematics and statistics as enjoyable subjects rather than abstract subjects that involve relentless calculations and theoretical work. This is clear from students' comments on the author's classes. Students' feedback/comments also show that they find the problem solving questions set on practical applications of the theories highly beneficial and engaging. This contributes to enhancing the social climate in teaching rooms. Students learn more effectively as they become relaxed and develop positive attitudes to the subjects.

A regular dialogue is maintained with students, through e-mails and the virtual learning environment, sending study materials and posting topics for discussion.

Danny's Case: Some characteristics Danny displayed are listed below:

- Showed a strong preference for a structured systematic approach
- Became easily distracted and anxious by any interruption or anything unusual such as a student coming in late and seating next to him/her
- Preferred to work on his/own and in silence
- Appeared unfriendly and got extremely irritated if any students or the author tried to talk to him/her especially when he/she was working on a question

These are commonly found in students with AS (Cambridge University, 2009). The author provides all students with a detailed class format providing guidelines about what to expect from classes and how to prepare for them in order to participate in class activities. This is an important aspect of her teaching approach designed to enhance student engagement and promote participation. Danny particularly benefited from having these details in advance as he stated that he liked the defined structure of class format.

Two weeks after teaching commenced the author received an email from him with a query about the online student registers. "... I think there is a slight error on it. It's only very minor, but I like things being accurate!" Students who have AS can be

intolerant of human mistakes which can be seen in Danny's reaction to the perceived error that actually worked in his/her favour and yet Danny wanted it corrected. The author had awarded him a grade higher than his actual grade shown on Danny's script, after seeing Danny's outstanding class work performance. This is in line with the author's procedure of amending actual grades if the class work on the same topic shows a remarkable improvement. This practice is explained to all students at the outset which encourages students to improve their work by engaging with problem questions in author's classes. Danny may not have clearly understood this and was satisfied when the author replied to his email explaining that she had amended his grade considering his impressive class work.

He preferred to work alone or with the author as opposed to engaging in group work and always insisted on sitting in the front row where he seemed most comfortable. He found it highly distracting when late-comers sat next to him.

Danny did not like any changes to the author's class format he had got used to. This was effectively dealt with by the author who ensured that any changes were clearly explained to him and detailed guidelines provided.

There was a happy ending to this case and Danny performed well in the summative examination. The university disability office had allocated a quiet room for Danny which made all the difference.

The Outcome and discussion

The author's approach has a positive impact on students' perceptions of the lectures and classes which is reflected in students' engagement, classwork, coursework and unprompted feedback. All students whose comments are included in this article are informed at the outset that their feedback/comments may be used for academic related purposes and have given their consent.

Qualitative feedback from students is very informative, as it highlights specific areas of the author' approach that students appreciated as below:

> "Very enthusiastic teacher who truly cares about the well being of the students"
>
> "...is indeed a teacher who is genuinely concerned about our work, which spurred us to work harder to improve ourselves."

Further, acting more as a facilitator (someone who helps students solve problems, by discussing them and pointing students in the right direction) than a teacher (an

individual who imparts education/information to students) seems to have encouraged independent thinking, reflective skills and enhanced confidence which extended beyond the courses, as expected. The author allows students to work in the way that suits them best. She discusses problem solving questions with them pointing them in the right direction to help them solve questions themselves rather than providing them with correct solutions. This works well with the undergraduates who dislike prescriptive/imperative statements.

> "She was very good at playing an enabling role – she didn't just giving the solution, but steered us towards the solution by providing a clue as to where we might be going wrong. When you finally reached an answer it gave you more confidence in your own ability, as you knew you had actually worked all the steps yourself and resolved your problems with minimal teacher input."

Formative assessments at the beginning of lectures/classes seem to have improved students' perceptions of their individual progress making them receptive to the material covered.

> "I like that you start the classes with the slides which are closely linked with the material covered on the lectures and home exercises, because it helps to revise the topics and keep up-to-date."
>
> "... is a great class teacher who offers good examples of the work covered....I generally enjoy classes and feel that the classes offer a relaxed environment which is excellent for learning."

The following quote shows that the author's aims of eliminating anxiety related to learning the subjects, promoting student engagement and enhancing student participation are fulfilled.

> "I like that you are very friendly with students which excludes any tension during the classes and creates a stimulating environment with everyone involved."

Problem solving questions on topics of students' interest enhanced the learning climate in the teaching rooms, making it conducive to increasing student participation and engagement.

The discussed approach has improved students' perceptions of mathematics and statistics courses taught by the author as reflected in their unprompted feedback, improved coursework standards and enhanced engagement. It has generally improved students' attitudes towards the subjects and enhanced their engagement

with the courses. This is evident in excellent student attendance, students' positive comments on mathematics/statistics and enhanced commitment to classwork Finally, students with specific learning differences require appropriate attention by well-informed academics willing to allocate additional time and effort to address specific guidance and support needs such cases may have. Danny benefited from the author's approach but it is crucial to be patient and considerate to behaviour patterns that may appear unusual to those unaware of the characteristics of students' with AS.

Conclusion

The author's student centred teaching approach encourages all students to engage with learning mathematics and statistics, promoting inclusive teaching practice as hypothesised. This is evidenced by the students' commitment reflected in almost 100 % student attendance even in Fridays' 5pm classes and 100% classwork questions submissions/standards.

Teaching and learning activities focused on enhancing the students' learning experience promoted greater participation, and created a positive impact on students' perceptions of mathematics and statistics. This is evident in students' comments on authors' classes (Kotecha, M. 2012).

The author intends to continue to develop her research theme.

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