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Less Anxious, More Confident: the Use of Playful Pedagogy to support student learning of quantitative methods

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Abstract

This paper presents findings from an evaluation of the Manchester Metropolitan University's Q Step Centre's uses of playful pedagogy to decrease undergraduate students' anxiety and increase confidence when working with quantitative data. Students studying social science degrees often associate themselves as 'Non-STEM' due to previous bad experiences of maths, therefore, when students enrol onto a quantitative methods module this causes anxiety amongst the students. Through incorporating playful pedagogic techniques and bringing elements of fun to teaching sessions, this reduced anxiety and increased confidence in the learners, thus creating data confident social science graduates.

Keywords: *Quantitative; Statistics; Pedagogy; Playful; Undergraduate*

1. Introduction

STEM vs Non-STEM

Secondary school Mathematics is considered a key factor when developing students' confidence to pursue a degree and career in STEM related subjects (Cannady et al, 2014), with MacDonald (2014) arguing that due to students' past experiences of mathematics, people create non-STEM identities where those that lack STEM skills accept that it is a part of who they are, and share this identity with others holding the same perception. As part of this identity, students establish attitudes towards their identity (Smith and Hogg, 2008) that can affect educational outcomes. This divide is not new, with CP Snow's "The Two Cultures" (1959) identifying that intellectual's conception of the skillset required for science and maths, and the skillset required for literacy are mutually exclusive. In particular, we can see this today within the discipline of Sociology with the dichotomy between quantitative and qualitative research methods. The majority of students that come to study Sociology at university, have often studied A-level Sociology due to its direct pathway to the degree, where research methods over privilege

qualitative research. Furthermore, Sociology is often branded as a Bachelor of Arts and based within the humanities subjects, which Snow (1959) would refer to as the 'literacy' culture, so when students come to university and enrol onto a quantitative methods unit, this creates anxiety due to their association between maths and statistics from the creation of their negative dispositions through bad experiences from school (Onwuengbuzie et al, 2003; Katz, 1993).

Anxiety

Negative dispositions towards numbers come from previous poor encounters with mathematics (Katz, 1993) that leads to the lack of confidence to engage with numbers in everyday life (Chinn, 2012; National Numeracy, 2016). Onwuegbuzie et al (2003) identifies that nowadays, more students are required to participate in statistics and quantitative methods; this has seen statistics anxiety increase by up to 80% in graduates. In particular, the Nuffield Foundation funded 15 Q-Step centres in the UK, to increase quantitative skills due to a national shortage, which meant more social science degree programmes would include more quantitative methods. Students see statistics as 'maths', which triggers negative attitudes due to their previous negative experiences (Onwuengbuzie et al, 2003), especially as most students have a two year 'maths gap' that they acquire between ending compulsory maths and starting university (Scott Jones and Goldring, 2014). Roberts and Saxe (1982) report students having high levels of anxiety when arriving at their first statistics lesson therefore, it is our job in higher education to create a supportive space where students feel confident and comfortable to learn statistics, especially those that identify as Non-STEM (MacDonald, 2004).

Theoretical Model

Tapia and Marsh (2004) identified four components of their attitudes to mathematics inventory that has been used worldwide across different age groups to measure attitudes towards maths (Afari, 2013; Majeed, Darmawan and Lynch, 2013; Lim and Chapman, 2013). We use these four components to understand how they contribute to shaping our students' attitudes and dispositions towards statistics.

Enjoyment

Enjoyment comes from students having a fondness for their classes and engagement in tasks that is supported by fun teaching that creates excitement for students (Kalder and Lesik, 2011; Coltman and Whitebread, 2008). A sense of enjoyment through pedagogy can emit emotions of interest and joy (Gray, 2013) that can later create fondness of those tasks (Kalder and Lesik, 2011). Therefore 'playful pedagogy' is crucial for students enjoyment of tasks and for their academic progression, with Rodarte-Luna and Sherry (2007) identifying the use of humorous cartoons and gimmicks decreasing anxiety amongst students.

Confidence

Lack of confidence in working with numbers can come from maths anxiety which can impact students succeeding in further studies (Onwuengbuzie et al 2003) and avoiding situations where maths is involved (Chinn 2021). The complication arises as students see quantitative methods as maths, therefore it is important for us to untrain this thinking and to increase students' confidence when working with numbers to not allow it to impact their further studies. Kalder and Lesik (2011) believe confidence arises when students can successfully deal with and complete tasks.

1.1. Teaching Styles in Higher Education

Teaching in universities has long been characterised by didactic approaches to teaching and learning (Biggs 1999, Ellsworth 1997). This approach is formal and reinforces a clear power dynamic between teacher as 'expert' and student as 'novice'/learner. Formality, authority, and privileged knowledge are therefore constructed and performed within teaching spaces; in this model the teacher is the 'sage on a stage' (King, 1993) and the experience can passify students. Universities have shifted away from the most stringent version of this model, with many decentring approaches whereby the teacher becomes the 'guide on the side' (King, 1993), the classroom 'flipped' (Van Alten et al, 2019) and the student positioned as an active agent in their own learning. Of course, formality and power differentials remain and can be reinforced by teaching spaces (such as lecture theatres), the increasing numbers of students in universities and teachers who lack skill and/or confidence. Often students may experience 'pockets' of 'flipped' approaches alongside more didactic ones. Moreover, these approaches place a great emphasis on students to be agents in their own learning and there is an assumption that by 'flipping' teaching spaces one will automatically create engagement and therefore success. Such emphases are problematic for students who bring educational 'baggage' to the classroom, such as maths 'anxiety' or stereotypes of specific subjects (Scott Jones and Cain, 2024). School maths curricula (Scott Jones and Goldring, 2014) is not learner-centric at UK KS3/4 (in contrast to KS1/2) and the STEM/Non-STEM identity dichotomy (Snow, 1959) reinforces the authority (and power) of the teacher. Sociology students encountering introductory statistics often feel 'anxious' and this is a barrier to learning that they bring to the classroom (Meyer and Land, 2005). They can be disengaged before they really have an opportunity to encounter a non-didactic approach to teaching and learning. Such students may view the lecturer as a STEM 'authority' and seek to see them as a 'sage' and not 'a guide', replicating former patterns and reinforcing stereotypes. 'Playfulness' is a pedagogic counter to this which introduces the decentring of classroom power dynamics through 'play' as a creative and exploratory activity, alongside 'playfulness' as an ethos that stresses informality, creativity and fun (Brown and Vaughan, 2010). This should be contrasted with 'gamification' (Dicheva and Dicheva, 2017) which emphasises 'gaming' and competitive activities to create 'fun' and engagement. Whilst

play and playfulness is well researched in primary settings; there is less research on it within post-16 settings. Often it is falsely conflated with 'gamification' but also because the pedagogic commitment to 'play' requires a shift in whole-programme planning and teaching, including, curricula, delivery, support, spaces and assessments. 'Play' and 'Playfulness' is a fundamental aspect of learning (Colarusso, 1993) that blurs the formal-informal boundaries and through this, students' relationships with teachers; students' agency can be reoriented away from 'anxiety' about statistics towards a positive view that can facilitate confidence and competence with statistical analysis.

2. Methods

The dataset contains two measures: one a newly designed statistics anxiety measure, adopting terminology from the originally Danish HFS-R measure (Nielsen, 2018; 2021), alongside a measure of students' views of Quantitative Methods (Williams, 2008). Both measures used commended techniques, creating a latent construct through a series of statements. Statements were Likert-style response systems, with anxiety being 4-points and confidence being 5-points; following reliability and validity testing.

The sample consisted of undergraduate social science students at Manchester Metropolitan University. Students studying Criminology or Sociology completed the survey voluntarily whilst studying their statistics modules at Levels 4, 5 and 6. Statistics modules at Levels 4 and 5 are compulsory, whilst level 6 is optional. Despite all Level 6 students being surveyed, an explanation for the significantly lower proportion in comparison to 4 and 5 is arguably due to the lower population of students opting to study at statistics at level 6 (Rosemberg et al, 2022). Given the need to avoid socially desirable responses, students were provided the option to complete during a session or at home. All responses were anonymous and it was made clear to students that they could not be identified nor did the survey have any implications on their grades. Students consented to take part knowing that upon submission of responses, their data could not be retrieved to additionally protect their identity. At the time of completion, all students were studying modules ran by the Manchester Met Q-Step Centre.

3. Findings

Table 1 shows the overall participation rate of students. 67.5%, are Level 4 students (*n*333), followed by 20.7% Level 5 (n102) and 11.8% Level 6 (*n*58). The total participants are 493 (*N*493), with percentages totaling 100%.

Table 1: Participation in the evaluation

Level of Education	Percentage *(frequency)*
Level 4 students	67.5% (*n*333)
Level 5 students	20.7% (*n*102)
Level 6 students	11.8% (*n*58)
Total	**100% (*N*493)**

3.1. Confidence

Figure 1 illustrates the correlation between the perceived impact of teaching style on confidence in studying quantitative methods and the corresponding academic year of students. The responses to the question "Has the teaching you have received on these modules improved your confidence in studying quantitative methods?" where a higher score indicates stronger confidence. The data reveals a coherent progression in confidence levels as students advance through academic years. Starting at Level 4 with a mean confidence score of 35.93, there is a consistent rise to 39.57 at Level 5, followed by a further increase to 43.58 at Level 6.

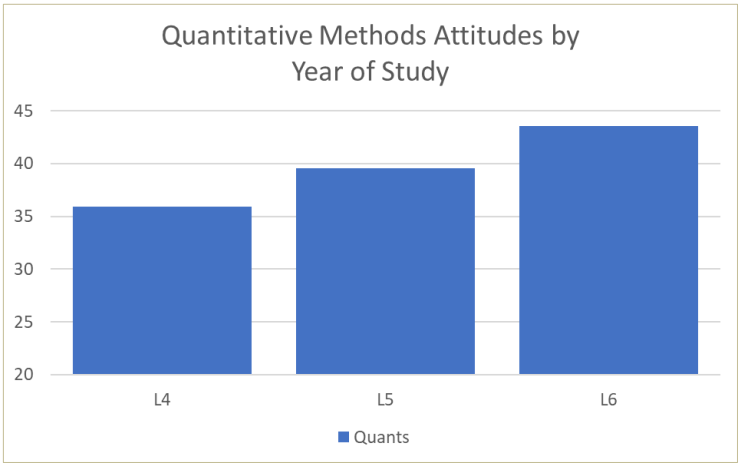

Figure 1: Confidence studying quantitative methods

3.2. Anxiety

Figure 2 illustrates students' anxiety of working with quantitative data. In the initial year (Level 4), the mean value is 45.78, with a notable reduction in anxiety at Level 5 to 43.65, followed by a further decline to 38.34 at Level 6. These findings emphasize a relationship between the advancement of academic years and the prevalence of statistics anxiety coinciding with an increase in confidence levels.

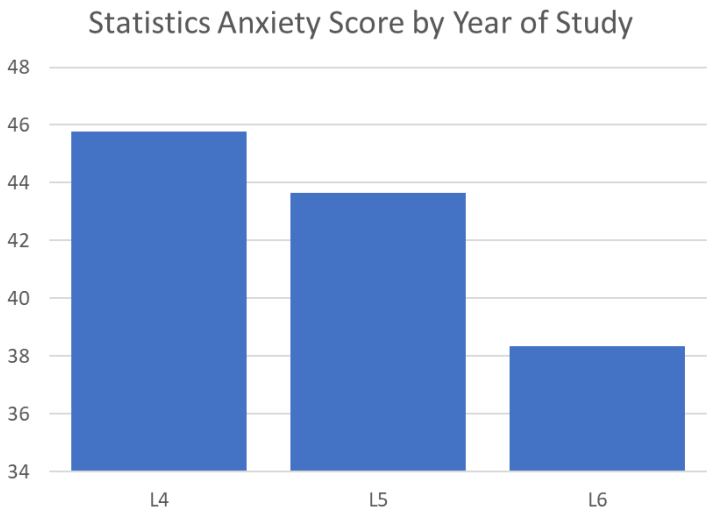

Figure 2:Anxiety working with quantitative data

3.3. Pedagogy

Interviews were conducted with students to better understand the reasoning behind their answers.

Participant one: *'Generally, I think they really standout, the way they teach.'*

Participant two**:** '*I think if there was no fun in it from the day one…a lot of people would have walked. I don't think they would have stayed.'*

Participant three: *I found that the teaching was really fun. You could get a lot of giggles. And I suppose that makes learning something quite enjoyable for anybody. If you have a laugh and a giggle while you're doing it.'*

4. Discussion

The findings presented in this paper suggest that by using playful pedagogy and making learning fun and engaging decreases anxiety and increases confidence amongst undergraduate social science students when working with quantitative data across all three year groups. As Colarusso (1993) highlights, the notion of play is a fundamental aspect of learning that allows students to focus on the fun being had in the classroom in relation to statistics, rather than their anxiety. Enjoyment through pedadgogy can create emotions of enjoyment and interest that can later create fondness of tasks (Gray, 2013; Kalder and Lesik, 2011), further helping to reduce anxiety and increase confidence (and therefore competence) in quantitative methods amongst social science students.

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