Blended Learning in Practice

Spring 2023

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Editorial

Welcome to the Spring 2023 edition of our e-journal Blended Learning in Practice. In this edition we have nine research articles from participants on the Post Graduate Certificate in Learning and Teaching in Higher Education (PGCertHE) programme at the University of Hertfordshire.

In this edition:

Ashley Spindler investigates through a series of semi-structured interviews the experiences of students with ADHD at the University of Hertfordshire. The study discusses the factors that allow students to thrive and the barriers that can hinder students getting the required support.

Fortunate Madondo has conducted a study that explored strategies which could be used to improve learning and teaching experiences for all students including international students at a higher education institutions (HEI) in the United Kingdom. The study recommends that HEIs should increase students' teaching and learning experiences through implementing a strategy such as translanguaging to enhance students' learning and teaching experiences.

Yiding Liu discusses the intricate formula derivations that are crucial skill-building exercises to improve students' learning activities in many engineering programmes. She has developed a simplified three-step decoding of the derivation process to support the explaining of some of the mathematical derivations to develop and enhance students' cognitive and constructive learning.

Flora Fortelius-Moring uses a focus group interview to investigate the experiences of two teacher educators supporting student teachers through the learning bottleneck of unpicking the theoretical and practical applications of inclusive pedagogy as embodied in the terminology of Adaptive Teaching. Her work highlights the challenges faced by teacher educators and the implications for professional development priorities.

Karrelle Forman-Evans considers current teaching methods and pedagogic theories to explore the value of group work in developing professionalism in undergraduate paediatric nursing students. She explores the tensions produced by the academic/practical divide and the skills allocated to, developed, and assessed in the two curriculum areas.

Kyriaki Corinna Datsiou explores the issue of Engineering being perceived as a male-dominated industry, despite the significant progress on occupational gender equality over the last couple of decades. She undertakes a detailed literature review to quantify the extent of this phenomenon internationally, nationally, and locally at the University of Hertfordshire.

Mike Colling discusses the role authentic assessment can play in enhancing employability of engineering graduates. He has carried out a literature review that focuses on three key

areas: graduate employability, the pedagogic theory of authentic assessment and methods of implementing authentic assessment. Mike proposes a model based on the principle of backward design as a possible way forward for practitioners.

Lisa Flint's article takes a broad look around 'Epistemicide', considering the destruction of values and knowledge systems. She has carried out a literature review around the challenges of implementing a decolonized praxis in terms of the role of libraries. Lisa looks at the literature around Epistemicide focussing on how collections are built, acquired, classified, catalogued, and accessed including the role of the 'reading list'. Paulo Freire's work on Critical pedagogy is woven into the discussion and the practicalities of 'critical librarianship' explored.

Yvette Boamah has conducted a study that explores the Instructional System Design (ISD) of a culturally responsive pedagogy approach to teaching Minor Illness and phenotypes. The implication is that student understanding of subject matter may also be consistent with what the students are exposed to in a clinical situation. The findings will assist nursing educators in adopting ISD theory to diversify the planning of their lessons to include multi-specific considerations in nursing education. She challenges the traditional pedagogic emphasis that is based on inflexible, clinically biased nursing epistemologies which do not consider multicultural relevance to current clinical practice.

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Ashley Spindler is a Lecturer on the MSc Data Science programme in the Department of Physics, Astronomy and Mathematics. She joined the University of Hertfordshire as a Research Fellow in 2018 after completing her PhD in Astronomy at The Open University. Ashley's research interests focus on the use of artificial intelligence in extragalactic astronomy, with a particular interest in the evolution of barred galaxies. They have also received an MPhys from the University of Surrey. As a lecturer with ADHD, Ashley has a strong drive to improve the experience of neurodivergent students at university, by raising awareness, being a role model and challenging stigma.

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Yiding Liu is a lecturer in Aerospace Engineering in University of Hertfordshire. She has a Master's degree in aerospace vehicle design from Cranfield University in 2015 and a Ph.D. in fatigue and damage tolerance from Coventry University in 2019. She was a research fellow at the University of Warwick from 2019 to 2021. Her research interests include fracture, fatigue and damage tolerance analysis of composite materials and adhesively bonded joints, static and dynamic finite element modelling of lightweight structures. She is very widely published and a Chartered Engineer, and member of the Royal Aeronautical Society and UK Tram.

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Flora Fortelius-Moring is a Senior Lecturer in Education at the University of Hertfordshire, focusing on inclusion and SEND in Initial Teacher Education. She has a first degree in Psychology with Sociology, a PGCE and an MA in Education. With a background in primary education, Flora is passionate about developing evidence-based practice rooted in person-centred approaches to improve the educational experiences of learners with Special Educational Needs and/or Disabilities. She joined the University of Hertfordshire in 2021, inspired by her previous experiences to support student teachers to become confident and committed inclusive practitioners.

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Karrelle Forman-Evans is a lecturer in the children's nursing team who joined the University of Hertfordshire in 2021. After graduating from the University of Hertfordshire in 2015, Karrelle previously worked within an NHS trust in various roles such as junior sister and practice developmental nurse. Her current research interests surround reducing the student to qualified paediatric nursing gap.

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Corinna Datsiou is a Senior Lecturer in Civil Engineering and a chartered engineer with extensive experience in structural glass and façade engineering. Corinna joined the University of Hertfordshire in September 2021. Prior to this, she completed her PhD at the University of Cambridge, followed by post-doctoral research at the University of Nottingham and designer experience in a consultancy firm specialising in glass structures. Her research lies at the interface of structural and materials engineering and focuses on glass mechanics, efficient manufacturing methods and composite units for structural glass.

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Mike Colling is a Lecturer in Aerospace Engineering at the University of Hertfordshire. Prior to becoming a full-time academic in February 2021, he was involved in wind tunnel testing and flight testing of military aircraft, and more recently worked as a pilot for one of Europe's largest airlines. Mike enjoys sharing his industry experiences with students and is particularly interested in how authentic assessment can enhance graduate employability.

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Lisa is an Information Manager within the Academic Engagement team in Library & Computing Services and works closely with the School of Life and Medical Sciences. She joined the University in 2013 from UCL, where she was a Subject Librarian, supporting students in UCL Medical School and The School of Life and Medical Sciences. Lisa gained her FHEA in 2020 and her experience lies in Information literacy and library related skills including undertaking systematic literature searching. Her interests include active and games-based learning as well as critical librarianship and decolonising and diversifying library collections.

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Yvette Boamah is a Senior Lecturer in the Health and Social Care Department. Yvette is an alumnus of UH having completed her Bsc Nursing, PgDip SCPHN, GPN, MSc Advanced Clinical Practice and PgCert in Learning and Teaching in HEI. Yvette contributes to the teaching and development of the Advanced Clinical Practitioner Course. Yvette is passionate about utilising the Advanced Clinical Practitioners to transform the National Health Service.

Experiences of Students with ADHD at the University of Hertfordshire: A Qualitative Study of Student Interviews

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Abstract

"The burnt-out, former gifted and talented kid," is something of a meme amongst the ADHD community, where perceived early success in education effectively masks the struggles of neurodivergent students, leaving them unprepared for the demands of work and further education. ADHD adults have been shown to be less likely to reach post-sixteen education, and those that do reach university underachieve compared to their neurotypical peers. This study, conducted through a series of semi-structured interviews, analyses the experiences of students with ADHD at the University of Hertfordshire. The interviews revealed that, when students are able to access the support available, they are able to thrive in their studies. However, it was also clear that there is a degree of gatekeeping involved in accessing support, due to difficulties in getting a clinical diagnosis of ADHD.

Introduction

Adapting to life at university is no doubt a significant challenge in any young person's life, but for students with ADHD (attention deficit hyperactivity disorder), the transition from adolescence to living and studying independently can prove especially difficult (Arnold et al., 2020; DuPaul et al., 2021). For many students, coming to university presents the first time living away from home, managing their own finances, and having greater responsibility in their studies. Higher education institutions (HEIs) provide opportunities for students to explore their own views and identities, which many find to be exciting and daunting at the same time (Pfeifer et al., 2020, 2021). It is important for HEIs to support all students in their studies and in regard to their mental health—especially for students with ADHD, who may be more vulnerable to mental health struggles and risk-taking behaviour (Wolf, 2001; Landberg et al., 2020; Sedgwick-Müller et al., 2022).

ADHD is a highly complex neurodevelopmental disorder, which affects a person's executive functioning. According to the American Psychiatric Association (APA, 2013) in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5), "People with ADHD show a persistent pattern of inattention and/or hyperactivity–impulsivity that interferes with functioning or development." Due to the complex nature of the condition, each person with ADHD presents with their own blend of symptoms—people are diagnosed with the inattentive-type ADHD (sometimes called ADD, or attention deficit disorder, which no longer appears in the DSM-5), impulsive or hyperactive-type, or with the combined-type. Students with ADHD have a wide range of struggles in university life, including focussing on

lectures, time-management, starting and completing tasks, meeting deadlines, restlessness, and emotional regulation (Sedgwick-Müller et al., 2022).

One of the difficulties of investigating the experiences and outcomes of students with ADHD in the UK higher education system, is that it is not standard practice to monitor the prevalence of the condition. As noted in the UK Adult ADHD Networks (UKAAN, Sedgwick-Müller et al., 2022) consensus statement on Students with ADHD, the condition itself is subsumed into the larger category of Specific Learning Difficulties (SpLDs). This category includes common conditions, such as dyslexia, developmental co-ordination disorder (DCD), and dysgraphia. While SpLDs make up the large percentage of declared disabilities in UK HEIs, according to the Higher Education Statistical Agency, ADHD actually only accounts for a small fraction of these students. These statistics are further complicated by the fact that many of these conditions are co-occurring.

Based on statistics from other university systems, such as in the Republic of Ireland, it is reasonable to assume that the rate of ADHD occurrence in the student population at UH is roughly 5% of those with a declared disability (AHEAD, 2018; Sedgwick-Müller et al., 2022). However, this is a lower-bound estimate, as a clinical diagnosis is required for ADHD to be declared as a disability and access to diagnostic services for adult ADHD is poor, with long-waiting lists and uneven coverage across the country (Lindsay, 2020). Because of this, it is not possible, to perform any large-scale analysis of the student population with regards to ADHD—such as looking for any awarding gap compared to neurotypical students.

In the last year, there have been some positive developments at UH, toward better inclusion and understanding of the neurodiversity of the student body. A Neurodiversity Reference Group has been set up in the School of Humanities and Education, the university celebrated Neurodiversity Week in April 2022, and there has been a greater push toward creating accessible teaching materials across all schools.

With these points in mind, the study presented here attempts to shine a light on the diverse experiences of students with ADHD and presents a series of recommendations derived from conversations with these students and the supporting literature.

Methods

The inspiration for this article then led to the formulation of the following research question: ‘What are the key characteristics for teaching evidence-based practice to undergraduate mental health nursing students in the United Kingdom, and what do pedagogic theories tell us about addressing challenges?’

The search was initially completed using four electronic databases: Scopus, CINAHL Plus, Cochrane Library and ERIC. The databases were selected to cover a broad range of health disciplines and educational approaches. No limits for language or type were used, this was to ensure inclusion of international research. Dates for original research were limited to the

last 10 years to ensure up to date evidence. Some further research was identified through reference lists and citations from the yielded evidence in the initial searches. Titles and abstracts were screened for suitability. An additional search for non-discipline specific pedagogic theory was conducted via the Online Library at the University of Hertfordshire.

Recruitment of participants

Students were recruited using a standard recruitment message, which was shared via the SPECS Academic Support Hub. Those interested in participating in the study were directed to contact the author directly, to preserve confidentiality. At no point was the ADHD-status of any student disclosed without prior consent.

The eligibility requirements for the study were intentionally broad. The study was open to any student with ADHD, defined as "having a clinical diagnosis of ADHD, seeking a clinical diagnosis for ADHD, or having self-diagnosed with ADHD." The purpose of casting such a wide net is two-fold: firstly, this study is already engaging with a small cohort of students; secondly, there are many reasons why an individual may not have a diagnosis of ADHD, and the experiences of those students are equally important as those who are diagnosed.

Twenty-seven students approached the author for further information; the majority of these had misunderstood or did not fit the selection criteria, while some didn't respond to follow-up emails to schedule the interview. In total, five students were recruited and interviewed for this study.

Interview Protocol

The study utilises a semi-structured interview protocol. The interviews took place in a private setting and follow a series of predefined questions. Using a semi-structured protocol, the interviewer is allowed to ask follow-up questions and elicit more detail and nuance during the interview.

The full interview protocol is provided in the appendix, and a summary given here. The students were initially asked to describe their experiences with ADHD. The conversation then moved onto discussing how the student adjusted to university life, and perceived differences with secondary education. Next, experiences with support services were discussed, such as any study needs agreements (SNAs) and the processes for accessing those. Finally, the students were asked if they have any additional needs not being met.

In addition to the formal protocol, the discussion often included details about how the participants accessed a medical diagnosis, their experiences in the workplace (for example part-time work or previous full-time work), and the impact living with ADHD has had on their mental health.

The interviews were recorded via Zoom, and the automatically generated transcript was extracted. The transcript was then edited for correctness, and identifying information was

stripped. The transcripts were reviewed broadly, looking for common themes across the participants responses. Once the broad themes were identified, each of the interviews was considered in further detail to ascertain their finer nuances.

Data Collection

In order to maximise the privacy of the participants, minimal demographic data was collected, with the questions asked focusing on subject, level, and mode of study, as well as their ADHD status. A description of the five students interviewed is provided here.

First, I will consider the subjects and modes of student of the participants. Interestingly, three of the five participants were mature students returning to university after time away from education—two of these were studying their first degrees, and one was undertaking a conversion master's course. Of the two students who entered university straight after college, one was a current undergraduate, while the other was a recent graduate, having completed an undergraduate degree and master's degree at UH. The subjects studied by the participants included Astrophysics, Aerospace Engineering, Data Science and Psychology. The undergraduate students were in their first or second years of study. Finally, there was a mix of part-time and full-time study, with one participant having made the decision to move from full-time to part-time during their studies. All five participants were home students, though finer grained demographics such as gender, and ethnicity were not gathered—due to the limited nature of this study, such information would have been of low value.

Four of the participants had a clinical diagnosis of ADHD, and the fifth was currently on the NHS waiting list. One of the participants had been diagnosed at a young age during primary education, one received a diagnosis as an adult before returning to university as a mature student, and two received their diagnosis while studying at UH. Three of the students presented with Combined-type ADHD, and one with Inattentive-type ADHD.

Results

The interviews proved to be fruitful and informative regarding the experiences of students with ADHD, though granted it must be noted that this study is limited by its size. Reassuringly, the responses highlighted that these particular students felt well supported by UH. However, it also became clear that the support systems were somewhat gatekept, relying on a medical diagnosis that is difficult to access.

The results presented here are broken up across a few main themes that were identified throughout the interviews. Extracts from the interviews are provided alongside the findings, to provide additional context.

Difficulties Faced with ADHD

All the participants reported that ADHD had a significant impact on their studies that made university more difficult, from their perspective, compared to their peers. The common themes through all the responses were organisational difficulties, trouble staying focussed, and keeping up with deadlines and responsibilities. For example, for one participant this manifested as struggling to balance work and study; they would forget when their lectures are scheduled when agreeing to attend their job at certain times of the day.

When discussing lectures, participants reported often losing track of what was being taught. They could be focussing on the lecturer in one moment, lose focus due to a distracting noise or tangential thought, and return to attention not knowing what they had missed:

> "Sometimes I feel like I am focusing on something, and I am giving it all my all. But then I realized that actually for the last few minutes I have been thinking about a multitude of other things or problems, or whatever's going on in my world, or even in stuff that's completely abstract, and I've actually been not listening as intently, or even at all, and I've actually completely missed some stuff going on." – Student 3, Astrophysics

Most of the participants reported use of personal recorders in their lectures. This strategy took the pressure off the students, so they didn't stress about always paying attention in the moment or take extensive notes. The flexibility afforded by personal recording equipment and software, which handles tasks like transcribing and organising notes (Garbutt, 2019), stood out as one of the primary means of managing the students' symptoms. Similar results were reported in Dobrowlski & Watson, (2022).

People with ADHD often report heightened sensitivity to noise (Jager et al., 2020), and this was shared across some of the participants. In both lectures and exam situations, the level of noise in a room was reported to be a significant barrier to the students. Interventions, including the use of low-occupancy rooms for exams, did help to alleviate this:

> "I also had the ability to do exams in a quieter room. which obviously help with not getting distracted by everybody clicking their pens although I probably did it too." – Student 5, Astrophysics and Data Science

> "I just wish I could wear some noise cancelling headphones in exams. But I don't think that's allowed." – Student 1, Aerospace Engineering

Online learning was also a feature of the responses, with concerns around the lack of structure that was felt by the students during the earlier stages of the COVID-19 pandemic. One student highlighted both the lack of motivation caused by online learning and the effect it had on their social life:

> "I can't build a structure. I get sort of lazy. If I don't have that structure of getting up, going to a lecture, having lunch… I feel like I don't have the motivation to do things, and I found it really difficult to sort of adjust to it, but I had already had to deal with that before with college. I just found it quite difficult, and also, I couldn't make any friends. It felt quite lonely, and I just—I didn't feel as though I could really try my best, because I didn't have that structure." – Student 1, Aerospace Engineering

Along with these difficulties, and others, the students reported affects to their mental health. It is widely reported that ADHD has comorbidities with depression and anxiety, which often stems from negative self-image, pressure to act and perform in a certain way, and a perceived failure to meet expectations (Katzman et al., 2017; Landberg et al., 2020). These experiences were echoed across the participants, which highlights the importance of mental health support for students with ADHD:

> "Teachers would say something on the lines of, 'this work is really good. Why isn't all the work to this standard? If only you applied yourself," and then sometimes moral personal qualities come into the discussion… 'if you weren't so lazy,' is the sort of implicit thing… As a result of these, what is often pitched as character defects, or you know, this is a personality, let's say. Thankfully, I'm in good mental health now, but I have struggled with periods of anxiety." – Student 4, Psychology

> "I did my first and second years as normal, and part of the way through my third year I was really struggling… It was the project module and having to juggle that with some other pretty hefty more physics-based modules that—it was the straw that broke the camel's back. I cried in my supervisor's office at one point." – Student 5, Astrophysics and Data Science

The experiences of students navigating expressed here inform the first recommendation of this report. Improving the awareness of ADHD amongst the student body, particularly in the wide range of presentations that differ from the popular expectation, would go a long way to supporting students who are struggling but don't know why. Amongst this guidance, the university should seek to better support students undergoing, or hoping to undergo, a formal assessment of ADHD. As the following section describes, there is a great difficulty in accessing clinical treatment for ADHD, due to long waiting lists and lack of information.

Accessing Treatment and Support

An important factor in accessing support at the university level is in having a medical diagnosis of ADHD. It was commonly cited throughout the interviews that accessing an ADHD assessment, particularly via the NHS, is exceedingly difficult. From experiences of gatekeeping by GPs, years long waiting lists, and finding alternative routes to a diagnosis,

the responses from the participants highlighted just how much of a barrier there is to overcome:

> "So, about 2 years ago, I kind of decided that I was going to sort of push towards having a diagnosis… and the only update I've had since then was about a month ago. I had another letter… that basically said, 'we haven't forgotten about you. But we still haven't got a timeframe,' and that's where it is now." – Student 3, Astrophysics

In discussions over the diagnosis pathway, responses spoke about the lack of information available and how they often had to work everything out for themselves. One particular point of note that was raised, is the existence of the Right to Choose (otherwise known as the NHS Choice Framework). In regard to ADHD assessments, the Right to Choose means that patients can ask to be referred to a particular clinic, which may be a private organisation instead of an NHS clinic, which have significantly shorter waiting lists—but this is not common knowledge amongst patients or doctors:

> "I looked into different avenues, and then I read about the right to choose in England. So, I went down that pathway, went to a Psychiatry-UK, and sent out a letter to my GP. I had to convince the doctor that it was a legit thing, because they had never heard of it before…" – Student 2, Aerospace Engineering

Supporting access to assessment and treatment for ADHD may prove to be a crucial area where the university can provide additional support for students. This could be through providing information regarding the NHS Right to Choose—as highlighted in the first of this paper's recommendations—or potentially implementing a system of in-house assessment, as suggested by UKAAN. One participant highlighted their previous experience as a university undergraduate, accessing an assessment for dysgraphia:

> "I believe there is funding that I was able to take advantage of at undergraduate level depending on—and I don't know if that's still a thing, because a lot has changed in the funding structure at universities—but sometimes the University can give you money towards getting assessments. So that's how I was able to get dysgraphia assessment." – Student 4, Psychology

Efficacy of Support Systems

Two areas where the student responses were generally positive, were in accessing support via the UH Student Wellbeing services and the Disabled Students Allowance (DSA). Across the board, participants praised Student Wellbeing for being supportive, understanding, and quick to respond. Through the DSA, participants have been able to access recording equipment and software. But, as with information around Right to Choose, it was noted that

finding out about the support available through Student Wellbeing and DSA was not always easy:

> "It didn't come through induction at all. I just sort of had that sort of insider knowledge." – Student 2, Aerospace Engineering

Four of the students interviewed had Study Needs Agreements in place, and the contents of these were uniform across the board. The participants agreed that they found the adjustments helpful. Additional time to take exams, and the ability to "Stop the Clock" were highlighted as important adjustments that reduced stress and improved the students' performance.

Lecturers were praised for making adjustments where needed, such as applying extra time to online quizzes and providing additional materials where needed. However, there was a note amongst the responses that teaching staff in general could be more aware of ADHD. This is particularly relevant for staff in pastoral roles, who might be in a position to notice when a student is struggling:

> "I think members of staff should have a broad understanding of [ADHD] potentially, not necessarily how to spot it, although I think you know at least be able to a spot where my attendance was going bad, and said, 'You don't know what this is, but go speak to someone.'… I think it could definitely benefit more people, maybe just kind of knowing what to look for." – Student 5, Astrophysics and Data Science

The second recommendation in this paper's conclusions are that staff should be given greater training toward recognising and supporting students with ADHD. Staff should be empowered to signpost students to support services and given a broader awareness of the stigma related to ADHD.

There was a disparity between experiences in early education and in the post-secondary environment. Only one of the students interviewed had a diagnosis of ADHD while in primary and secondary school—they felt that the level of support in their studies dropped off in the transition to university:

> "It was more structured, and I feel like the teachers—because the class sizes are smaller—they know you. They can come to you if anything is off, and they understand it a bit more because they're working around that. With lecturers, I feel like they understand it, but the class size is just too big to be able to acknowledge such things. And there's also a lot more extra help you can get at school than there is at university." – Student 1, Aerospace Engineering

A common theme amongst the rest of the participants, was the experience of performing well in early education that they felt masked their symptoms. It is only once these students

reached A-levels, careers, and university where they began to struggle to keep up with the demands of their studies. This step change in performance then led onto feelings of inadequacy and anxiety for some students:

> "And then in college I started doing some subjects that I really didn't enjoy... I didn't focus on that at all, and I wouldn't turn up to lectures. I didn't do so well in those A-levels... I had very poor attendance, and I just I wouldn't apply myself. I couldn't concentrate in class. Really, I just sort of—my mind would check out. And yeah, I didn't do so well in college." – Student 2, Aerospace Engineering

> "I did my first and second years as normal, and part of the way through my third year I was really struggling. I mean, I was struggling in the second year, a lot. It was the project module. and having to juggle that with some other pretty hefty more physics-based modules that—it was the straw that broke the camel's back. I cried in my supervisor's office at one point." – Student 5, Astrophysics and Data Science

Discussion and Conclusions

While every student has their own unique experiences at university the interviews performed in this study have revealed some striking threads of commonality. Both positive and negative, these threads weave a narrative about the importance of recognition and awareness, the accessibility of support, and the emotional toll of neurodivergence in a neurotypical world. To conclude this narrative, I will summarise the main findings of the study and in doing so make recommendations to improve the learning environment for students with ADHD.

On the positive side, for students who have access to support services—such as study needs agreements and the Disabled Student Allowance—the help provided goes a long way. Access to bespoke recording equipment, exam arrangements, and one-to-one support from student wellbeing, were all praised by the participants. This study shows that, in this area, the University of Hertfordshire is doing something right. In fact, when asked if there were any additional individual supports the students would like to have put in place, the answer was a resounding, "No." Instead, the participants looked at the broader picture; wider awareness training for staff, identifying and screening students who are struggling, and more signposting about what support is already available.

The important caveat to the previous points, however, is these systems only work when students know that they exist and are able to access them. From a lack of awareness of what ADHD looks like in adults, a reliance on a diagnosis to receive full support, and the difficulty of accessing a diagnosis at all, there are enormous barriers that stand between a student recognising their ADHD and receiving support in their studies. Consider one of the participants, who is still awaiting an appointment to be assessed for ADHD after two years,

it's conceivable that a student could be referred for an assessment in their first year and be close to completion of their studies before being diagnosed. Tackling these barriers will allow more students access to the help they need and go a long way to improving the success rate of students with ADHD at UH.

The following recommendations have been developed with the results of this study in mind and are also informed by the wider literature—in particular drawing from the consensus statement from the UK Adult ADHD Network. It is the belief of the author that implementing all, or even some, of these action points will significantly improve the university experience for students with ADHD.

1. Improve the awareness of ADHD in the student body, highlighting the wide range of symptoms and presentations of the condition. Likewise, provide improved guidance and support to students seeking an ADHD assessment, including information around NHS Right to Choose.

2. Provide staff training around supporting and recognising students with ADHD and empower staff to signpost students who may be struggling to seek support. These programmes should include awareness around potential stigma related to ADHD.

3. Student wellbeing already provides diagnostic assessments for Dyslexia and DCD, UH could eliminate the lengthy wait times associated with getting an ADHD diagnosis by training the practitioners and assessors in student wellbeing to perform these assessments in-house. Alternatively, the University could extend the funds set up to provide diagnosis for SpLDs to students requiring an ADHD assessment.

4. Students presenting with learning difficulties, especially if in conjunction with anxiety or depression, should be screened for ADHD.

The University of Hertfordshire already has a strong foundation of inclusive teaching practices and improving support for students with ADHD falls perfectly in line with FACES values that university strives towards. There's no doubt that students with ADHD are well supported by the university, when they are able to access that support, but UH must do better to both signpost that support and do everything it can to alleviate the long delays to receiving assessment and treatment.

As a final point, the participants were asked what advice they would give to other students realising that they might have ADHD. A common theme in all the responses was, simply, "don't wait."

> "I would say, no matter how you were currently feeling, get your study needs agreement straight away, even if you never use your extra time. Get it. If you never think you'd need to stop the clock, get it—because the worst thing is that you don't use it, and the best thing is that it's there… Don't beat yourself up when you struggle with

things that your friends aren't necessarily struggling with, and if it takes you longer to do something, and then it doesn't matter." – Student 5, Astrophysics and Data Science

References

American Psychiatric Association, DSM-5 Task Force. (2013). (5th ed.). American Psychiatric Publishing, Inc.

Arnold, L. E., Hodgkins, P., Kahle, J., Madhoo, M., & Kewley, G. (2020). Long-Term Outcomes of ADHD: Academic Achievement and Performance. Journal of Attention Disorders, 24(1), 73–85.

Association for Higher Education Access and Disability (AHEAD). Numbers of Students with Disabilities Studying in Higher Education in Ireland 2017/18. Dublin: AHEAD Educational Press; 2019.

Dobrowolski, S., & Watson, S. J. (2022). Attention Is Not the Solution: Experiences of University Students with ADHD with Remote Learning. PsyArXiv.

DuPaul, G. J., Gormley, M. J., Anastopoulos, A. D., Weyandt, L. L., Labban, J., Sass, A. J., Busch, C. Z., Franklin, M. K., & Postler, K. B. (2021). Academic Trajectories of College Students with and without ADHD: Predictors of Four-Year Outcomes. Journal of Clinical Child and Adolescent Psychology : the official journal for the Society of Clinical Child and Adolescent Psychology, American Psychological Association, Division 53, 50(6), 828–843.

Garbutt, L. (2019). 'How Assistive Technology Helps Students with ADHD/ADD Achieve Independence'. Glean.

Higher Education Statistical Agency (HESA), UK-domiciled student enrolments by disability and sex: For the academic years 2014/15–2018/19

Jager, I., de Koning, P., Bost, T., Denys, D., & Vulink, N. (2020). Misophonia: Phenomenology, comorbidity and demographics in a large sample. PloS one, 15(4), e0231390.

Katzman, M. A., Bilkey, T. S., Chokka, P. R., Fallu, A., & Klassen, L. J. (2017). Adult ADHD and comorbid disorders: clinical implications of a dimensional approach. BMC psychiatry, 17(1), 302.

Langberg, J. M., & Becker, S. P. (2020). ADHD Treatment and Long-Term Academic Outcomes: Response to Arnold and Colleagues. Journal of Attention Disorders, 24(5), 819–820.

Lindsay, M. (2020). 'ADHD assessment system 'broken' with five-year waiting times', BBC News.

NHS. (2019). 'Your choices in the NHS'.

Pfeifer, M. A., Reiter, E. M., Cordero, J. J., & Stanton, J. D. (2021). Inside and Out: Factors That Support and Hinder the Self-Advocacy of Undergraduates with ADHD and/or Specific Learning Disabilities in STEM. CBE life sciences education, 20(2), ar17.

Pfeifer, M.A., Reiter, E.M., Hendrickson, M. et al. Speaking up: a model of self-advocacy for STEM undergraduates with ADHD and/or specific learning disabilities. IJ STEM Ed 7, 33 (2020).

Sedgwick-Müller, J.A., Müller-Sedgwick, U., Adamou, M. et al. University students with attention deficit hyperactivity disorder (ADHD): a consensus statement from the UK Adult ADHD Network (UKAAN). BMC Psychiatry 22, 292 (2022).

Wolf, L.E. (2001), College Students with ADHD and Other Hidden Disabilities. Annals of the New York Academy of Sciences, 931: 385-395.

Appendix

The following questions layout the semi-structured interview protocol. Students were provided with the list of questions before hand and had the interview process explained to them. They were informed of how the information would be used, and how they could withdraw from the student. This interview protocol was used for the purpose of academic improvement and is therefore covered by the Protocol for Reflective Practitioner Work By Academic Staff. As such, it does not require ethical approval.

- Let's begin with your name, what you are studying and what level of study you are at.
- Tell me about your ADHD; how does it affect you in a broad sense?
- When you started university, how did you adjust to the new experiences and expectations?
- How does university compare to your earlier education, in primary and secondary school?
- Does the university know about your ADHD? What was the process of informing them like?
- Do you have a study needs agreement in place? How did you find the process of accessing that?
- What kind of accommodations do you feel could be in place to better support your studies?
- Has there been a time when the accommodations provided by the university have helped you achieve something you might not have succeeded with on your own?
- Have you ever felt like your needs aren't being supported or understood in your studies?
- What advice would you give to an incoming student with ADHD? What about a current student who suspects they have ADHD?

Translanguaging as a Strategy to Improve Learning Experiences of University International Students using English as an Additional Language

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Abstract

Higher Education Institutions (HEI) are inundated with a mixture of students from diverse and multicultural backgrounds with some struggling to cope with their academic work. The degree of multilingualism among students varies from one institution to the other (Paradowski, 2010). As such HEI classrooms encounters are compounded by students speaking different world languages with some encountering English as an Additional Language (EAL). Among these are international Black, Asian, Minority and Ethnic (BAME) students who use EAL. This study explored some strategies which could be used to improve learning and teaching experiences for all students including international students at a HEI in the United Kingdom (UK). A case study research design that considered interviews, focus group discussions and University league tables was used to gather data from 20 participants. Using the social constructivist theoretical perspective, findings revealed that some international students, especially recent arrivals attending University in their first year, struggled to achieve better grades in their assessments both written and spoken due to challenges such as proficiency in English and the education system in the UK which might also be significantly different, in terms of resources, and access to technology, as well as the style of teaching. The study recommended that higher education institutions should increase students' teaching and learning experiences through implementing a strategy such as translanguaging to enhance students' learning and teaching experiences.

Introduction

Every academic year students from different parts of the world converge in learning and teaching encounters to share knowledge, skills, and experiences at institutions of higher learning (HEI) in the UK. However, very little is known about how these learning encounters optimize the use of more than one linguistic repertoire for cross-cultural pollination and positive student learning experiences. Although we are living in a global village where people from different cultures learn together, the use of English as a medium of instruction is common however, this might be a disadvantage to many international students especially those that take EAL who might lack confidence in using English language. The term EAL refers to a diverse and heterogeneous student body who encounter EAL. In the UK, this group of students is viewed as having been 'exposed to a language at home that is known or believed to be other than English' (Department for Education, 2020). In other words, the students already speak another language/s from their different home backgrounds before joining the University.

The British Census (2011) argues that students who use EAL are a linguistically diverse group; more than 300 languages are spoken by students in the English education system with Polish, Panjabi, Urdu, Bengali (with Sylheti and Chatgaya), Gujarati and Arabic being the languages spoken the most in England after English. As such EAL students are much less likely to be White than pupils with English as their first language - 30% of EAL students are White, 41% are Asian and 13% are Black; 85% of students with English first language are White, 4% are Black and 4% are Asian (Department for Education, 2020). When arriving in the UK, international BAME students may differ in their stages of developing English language proficiency, from New to English, to completely Fluent (The Bell Foundation, 2022). The 2020/21 League tables at the current study context indicate that module attainment stood at 59% Asian/Asian British against 64% Whites, Black/Black British 56% against 64% Whites, Chinese 58% against 64% Whites and other Ethnic backgrounds is 61% against 64% Whites. Such disparities in the module attainment gap prompted the researcher to conduct a study of this nature to close the academic achievement gap between BAME students and their White student counterparts.

The other concern was that there were limited studies that the researcher was aware of which have explored translanguaging as a strategy to improve students' learning experiences in UK higher education focusing particularly on international students who use EAL. This study is therefore the first of its own kind to try and implement translanguaging to enhance learning experiences at the current study context. Initially the researcher was motivated to conduct this study because of the results from informal interactions which occurred around the two campuses with international students who indicated that their challenges in academic performance basically revolved around the use of English as the medium of instruction in all their learning. Not only this, but the researcher was also inspired to conduct the study as a way of fulfilling the University's mission to transform communities and society through research and innovation. Thus, the study came in at the right time especially this year when the institution recruited a significant number of international/BAME students in the 2022-23 academic year.

To proceed, the paper assumed the following structure, I began by unpacking the concept of translanguaging through discussing related literature and previous research studies on the phenomenon. Furthermore, I described the methodology, presented, and discussed the research findings. Three research questions formed the basis of the study. They included, how translanguaging could be implemented to effectively enhance learning and academic performance for all students including English first language speakers and international students who use EAL? What challenges do international/BAME students face in teaching and learning at HEIs? and Which strategies could be put in place to mitigate challenges faced by international/BAME students in teaching and learning at HEIs? The paper ended by highlighting conclusions and giving recommendations for policy and further studies.

What is Translanguaging?

Researchers in the fields of sociolinguistics and applied linguistics have extensively explored the concept translanguaging, a term that Williams (1996) first proposed as 'trawsieithu' in Welsh and more recently expanded as a theoretical and analytic concept in a wider context by Garcia (2009) and other scholars (Blackledge & Creese, 2010; Canagarajah, 2013; Creese & Blackledge, 2010; Li, 2011, among many others) mainly from people who use EAL. Several scholars have adopted the translanguaging lens and significant amounts of work have been developed around the concept, exploring it further, reshaping it, employing it to new contexts, and critiquing it as well as weighing the risks involved in its transformation (Jaspers, 2017). Translanguaging is both going between different linguistic structures and systems and going beyond them (Li, 2011; Paradowski, 2010).

The term translanguaging refers to 'the ability of multilingual speakers to shuttle between languages, treating the diverse languages that form their repertoire as an integrated system' (Cummins, 2007: 223). This view of translanguaging can be problematic because it leaves out other important attributes of communicating one's ideas which are covered in the next definition. Translanguaging involves the ability to engage in activities that seek to empower students to choose their mostly preferred language, for instance, making notes (i.e., making their own notes in teaching and learning sessions or from a text, organising graphics or during practical activities/work), in a language that they best understand, English or a mixture, making oneself understood or making sure that one understands or conveys a certain nuance of meaning, creativity, or criticality (Mateus, 2014). This definition of translanguaging is more interesting because it includes various aspects that students can use to convey meaning and enhance understanding. A translanguaging perspective suggests that multilingualism is not the full mastery of more individual or separate languages. Instead, multilingualism is viewed as dynamic, with translanguaging as the authentic way that multilingual individuals, families, and communities communicate (Baker & Wright, 2017). From the above it can be inferred that in translanguaging languages are not separated in the mind of the multilingual person; rather, the multilingual mind is seen as a holistic system that contains diverse linguistic resources, employed as needed for different communicative purposes.

The idea of multilingualism is not a new phenomenon, many countries 'have two official languages (usually a strong indigenous variety and a widely used European one) for highly heterogeneous and multilingual populations' (Edwards, 2013: 6). Multilingualism may be because of political union among different linguistic groups for instance, immigrants bringing in their own native languages and their children being introduced to new languages in the newly relocated context. Research is brimming with evidence of various substantial long-lived cognitive, social, personal, academic, and professional benefits of enriched bilingual and/or multilingual contexts (Thomas & Collier, 1998). The advantages that multilinguals exhibit over monolinguals are not restricted to linguistic knowledge only, but

extend outside the area of language (Cook, 1999; Cook, 2001). A case in point is the ability to juxtapose English with other different languages and communication strategies through translanguaging.

Scholars that have explored the advantages of allowing students to engage in translanguaging during sessions concur that there is increased lesson accomplishment (Lin & Martin, 2008; Arthur & Martin, 2006). It can be argued that through translanguaging no student is left out as all students from diverse backgrounds feel included in the sessions. Other studies indicate that translanguaging manages to find a common ground on the power-relations within the different languages in class (Cummins, 2007). This happens when different languages are equally empowered with none being regarded as more powerful than others. Apart from this, some studies argue that translanguaging helps to increase participant confidence and motivation (Creese & Blackledge, 2010; Lin, 1999). For instance, when one speaks in a language that they prefer most they are more confident as opposed to when they speak in an additional language that they are less confident in.

In a study which explored the use of translanguaging strategies on bilingual learners and how the strategies supported learners' English language development, Chaplin (2016) found out that translanguaging enhanced students' English language development. Canagarajah (2011) argues that translanguaging is not a modern phenomenon but there is evidence that translanguaging has been practiced in pre-colonial communities and in rural contexts. This is certainly true in the case of South Asia, Africa, and South America, where rural life has been characterised by heterogeneity and multilingualism. A case in point is the researcher's personal dynamic experiences with Shona language which has many dialects in Zimbabwe and when villagers meet, they adopt translanguaging to converse depending on context. Although this is the case, these rich informal linguistic repertoires are unfortunately not documented in modern scholarship. 'The limitation in the scholarship on translanguaging in pre-colonial times is that it is not based on empirical observations' (Canagarajah, 2011: 4) but on archival research. Studies show that apart from being used in informal conversations translanguaging can be a useful way to differentiate the curriculum. Differentiated instruction adapts learning to students' unique differences (Chapman & King, 2005). Levy (2008) argues that by using differentiated instructional strategies, educators can meet learners' various needs and help them to meet and exceed their full potential. Some scholars argue that translanguaging can support individual students in planning, drafting, and producing a text (Velasco & Garcia, 2014).

Theoretical Framework

The current study adopted the social constructivist perspective which believes that knowledge is a social construct which occurs through interactions with other people, their culture, and society at large (Vygotsky, 1978). The theory further states that students depend on more knowledgeable others or peers to learn new skills, knowledge, and

experiences which links well with the current study where translanguaging can create opportunities for students to learn from each other.

Methodology

The data in this case study came from 5 home White students and 15 international/BAME students from China (Chinese students, form a large proportion of international students within the University), Algeria, Pakistan, and Bangladesh. Purposive sampling was used to identify the participants. Nicolopoulo (2022) states that purposive sampling is a non-probability sampling technique through which the subjects are selected for a purpose. For instance, in this study international students who used EAL were purposively selected. The other procedure used was simple random sampling which is a probability sampling procedure that enabled participants to be randomly picked from the entire population (Nicolopoulo, 2022). In other words, each participant had an equal chance of being selected.

Lecturers from two schools within the participating institution gave permission to the researcher to talk for 10 minutes about the research in two separate sessions. Consent from the students was sought first and the researcher assured them that the collected data was to be used for academic purposes only and that they were free to withdraw from the study at any time they felt like. Manti and Licari (2018) argue that consent is obtained before the participant enters the research (prospectively), and the researcher should not influence participants to consent. All volunteers were given an equal opportunity to participate by picking yes, or no papers placed in 2 boxes, one for home and another for international/BAME students. Those that picked yes papers automatically qualified to participate in the study. Because the researcher wanted to gather qualitative data regarding how translanguaging could be implemented to effectively enhance learning experiences and academic performance for all students including international/BAME students that use EAL, and challenges they faced as well as identifying strategies that could potentially employed to overcome the challenges, interviews and focus group discussions that lasted for about 30 minutes per session and the current institution's league tables were used as data sources. Data was analysed thematically and presented through thick narrative descriptions. Pseudonyms were used to protect participants' identities and to maintain confidentiality and anonymity.

Findings

Data was collected, analysed, and presented following two major themes which emerged from the results. Participants were asked a series of questions in both interviews and focus group discussions which included: What challenges were they facing as international students who use EAL? How best could translanguaging pedagogy be used for classroom instruction? Which languages did they prefer to use during classroom interactions? and What strategies could be used to overcome the challenges they were faced in using EAL? The themes were presented in the sections to follow.

Challenges faced by international students who use EAL

Results revealed that some international students that used EAL faced four major challenges in their learning and interactions which included:

- Struggling to cope with the accent and pronunciation. Three participants concurred that 'when English first language speakers spoke in class, they talked so fast, and it was difficult for international students who used EAL to understand what they would be saying because of the accent and pronunciation of words.' (Focus Group Discussion 1- Joe, Craig, and Dave not real names). This is an indication that some students struggled with the general cognitive processing of English as an additional language.

- Struggling to produce very good academic essays and presentations was the other challenge. For instance, one student said, 'I feel that as international/BAME students we are not receiving adequate support regarding our written academic essays and presentations.' (Interview - Hin not real names). Another participant said, 'I wish we could be allowed to write in our own home languages like Hindu then the assessments would later be translated to English to improve our performance' (Interview – Kan not real name). These results from interviews showed that students required support in assignment writing and to be given an opportunity to be creative in using different languages in their writing.

- Lack of confidence presenting in class was the third challenge coming from the participants. Four international/BAME students using EAL said 'We are not confident when presenting in front of other students because of our own accent which is different from the British accent. Other students often complain that they cannot hear us clearly which then kills our confidence' (Focus Group Discussion 2 - San, Jit, Pa, and Anna not real names).

- A group of 10 international Chinese students identified failure to make friends and participate in group tasks in their classes due to the use of EAL a major barrier to their learning experiences. In a focus group discussion, they commented that 'We find it difficult to interact with others in class because our English is not that good. Some students show interest in working with us but in most cases, we spend most of our time translating English to our home language to comprehend what they will be saying thus they lose patience and think that we do not want to talk to them and yet the truth is that we will not be understanding most of the things said in class.' (Focus Group Discussion – Chinese students – Kay, Jay, Ray, Thai, Fay, Pay, May, Ray, Day, and Gay not real names).

It is clear from the above findings that international students who use EAL faced several challenges that negatively impacted on their learning experiences. Apart from the challenges, results revealed that participants suggested some strategies to address the identified challenges. These were presented in the next section.

Strategies to address challenges faced by international students who use EAL

Four strategies emerged from the findings. To begin with, based on the data obtained from participants through interviews and focus group discussions, findings revealed that one way to address issues to do with written academic essays and presentations was for the institution to engage editors who could help with editing students' assignments. For instance, one participant said: 'It would be helpful if the University could get us editors to edit our written academic essays and presentations before submission to enhance our academic performance' (Interview - Hin not real names).

Another strategy which several participants concurred with was the idea of investing in translators. For instance, participants said, 'since we pay a lot of fees and bring in revenue to the country, the institution could provide translators in classrooms so that e.g., when international students were presenting in class they could present in languages of their choice e.g., Chinese, or Hindi mixed with English and/or another language or symbols. Then native or home English speakers could wear some translation headsets to listen in English. This would increase our level of confidence. We see this happening e.g., at United Nations conferences meaning our institution could invest in such technologies.' (Focus Group Discussion - Joe, Craig, and Dave not real names).

They added that confidence played a larger role in both verbal and written forms of communication. Participants also suggested that sessions could be flexible enough to allow them to practice translanguaging especially in their written work and during classroom presentations as a way of increasing their confidence levels and proficiency in English.

Chinese students suggested that the University could employ qualified Chinese language translators in sessions where there are large numbers of Chinese students to enhance their learning experiences. They also suggested that more lecturers representing diverse cultures could be employed to deal with linguistic issues. One participant said, 'linguistic level is of no importance, it's all about celebrating the diverse range of languages spoken within our community'.

Discussion

Several Universities are concerned with the decline in student enrolment nationally and they are now finding ways to attract international students to boost enrolment figures and maintain the relevance of programmes. However, although numbers of international students have increased significantly, the figures might triple if institutions attempted to decolonise the curriculum by being flexible in the teaching and learning. By decolonising the

curriculum, I mean employing adaptable strategies to accommodate everyone for example, by employing translanguaging. Through translanguaging all learners feel satisfied that they have been understood and the cross-cultural pollination of languages in the sessions means that other people who do not speak the same language can learn some vocabulary from a different language. This can be referred to as decolonisation of the language of instruction.

There is no consensus on the definition of decolonisation. Martin, Stewart, Watson, Silva, Teisina, Matapo, and Mika (2020: 313) argue that decolonisation "must be understood within the context of coloniality in order for it to be de-contaminated which therefore raises the question of whether curriculum can possibly be decolonised because it is colonial in-and-of-itself?". It is obvious that the definition points out the importance of acknowledging the historical background of the term decolonisation to produce a contextualised meaning. Zembylas (2018: 404) supports this view by adding that decolonisation is "a historical narrative that resists Eurocentrism and acknowledges the contributions of colonised populations across the globe". Based on these perceptions, in the current study, decolonisation is viewed as recognising ethnic languages and giving them the same value with English to ensure effective teaching and learning. In other words, one can argue that decolonising the teaching and learning curriculum should begin with the educator. However, educators must desist from being authoritarians in their sessions by allowing students to take charge of their own learning. It is necessary to note that when a monolingual educator encourages students to take risks that is a different story, and a different one when the educator models good practice or what taking a risk might look like (Yilmaz, 2019). In general, taking risks in linguistical terms like practicing translanguaging might be a good start to ensure effective learning.

Language is a rich cultural tool (Vygotsky, 1978) that many countries protect and preserve. Results from the current study indicated that international students paid substantial amount of fees, and the University should certainly invest in their learning experiences to enhance academic performance. Results from the current study can further the discussion around scholarship for learning. 'There may be three ways of being scholarly {in teaching and learning}: (1) reflecting critically on practice; (2) using ideas from the literature; (3) contributing to the literature' (Baume & Popovic, 2016: 6). Findings revealed that international/BAME students spoke and used more than one language hence the need to afford them opportunities to use translanguaging in their learning and teaching. This corroborates with previous studies which emphasise that translanguaging enhances learning to be fully maximized (Hornberger, 2005; Yilmaz, 2019).

Conclusions and Recommendations

We may conclude by arguing that a translanguaging pedagogy is an essential tool for decolonising the teaching and learning curriculum in higher education. It can help to cater for the unique individual learning differences among students particularly the minoritized

international students that use EAL whether they are emergent bilingual or not, because translanguaging helps in building on students' linguistic strengths (Mateus, 2014).

The researcher recommends that institutions of higher learning, should invest in acquiring specialist human translators, and translation equipment. An example may include the use of human/technology translators in lectures (e.g., if there are many Panjabi speakers in a class, a different language from Panjabi may be used and students can put on headphones and listen to a translation in English or whilst the Panjabi speaking students are presenting other students could put on headphones to understand clearly due to pronunciation issues). This initiative can attract many international students that use EAL as they will be able to learn in a language, they understand best and use their working English to communicate and interact with others but when it gets to serious business of learning they do translanguaging. Translanguaging can also help them in perfecting English as an additional language since they will be learning it without pressure but in an interesting manner.

The study also recommends that schools within the University should start a compulsory module on all courses called English as a New Language to enhance international/BAME students' English language competency.

The other recommendation is for lecturers to design translanguaging assignment tasks to explicitly "bridge" international/BAME students' developing competencies in English and their home language to build upon their existing writing skills. For instance, international/BAME students can be paired with a first English speaker collaborative partner to work on the task and consequently instructed to alternate the languages they used to write the different sections of their texts, to provide them with targeted practice in each of the instructional languages. For example, students can write 'causes of poverty' in English and 'effects of poverty' in Panjabi. The educator can model flexible bilingualism, by fluidly switching between languages or using one language to process content in the other. Students can then start to translate their writing to create a fully bilingual text. Translation then becomes a valuable skill to be developed. The difference between word-for-word and translation for understanding can also be explained.

Finally, the researcher recommends that further studies that will compare academic performance of international/BAME students after implementing translanguaging should be considered to check whether there is an improvement or not.

References

Baker, C., & Wright, W. (2017) Foundations of Bilingual Education and Bilingualism.

Clevedon: Multilingual Matters.

Canagarajah, S. (2011) Translanguaging in the Classroom: Emerging Issues for

Research and Pedagogy. Applied Linguistics Review. 2, 1-28. 10.1515/9783110239331.1.

Chauhan, V. (2020) All in regularising ethnic presence in the curriculum.

Chapman, C., & King, R. (2005) 11 practical ways to guide teachers toward differentiation (and an evaluation tool). Journal of staff development, 26(4), 20-25.

Champlin, M.J. (2016) Translanguaging and Bilingual Learners: A Study of How Translanguaging Promotes Literacy Skills in Bilingual Students.

Cook, V.J. (2001) Using the first language in the classroom. Canadian modern language review. 57(3), 402-423.

Cook, V.J. (1999) Going beyond the native speaker in language teaching. TESOL Quarterly 33(2), 185-209.

Creese, A., & Blackledge, A. (2010) Translanguaging in the Bilingual Classroom: A Pedagogy for Learning and Teaching. The Modern Language Journal, 94, 103-115.

Cummins, J. (2007) Rethinking monolingual instructional strategies in multilingual classrooms. Canadian Journal of Applied Linguistics, 10, 221-240.

Department for Education (2020) English proficiency: pupils with English as additional language.

Edwards, J. (2013) Bilingualism and multilingualism: some central concepts: The Handbook of bilingualism and multilingualism. Second Edition. London: Blackwell Publishing Ltd.

Gunnarsson, T. (2010) Translanguaging: A review of flexible language use on students' learning of additional languages.

Hornberger, N. H. (2005) Opening and Filling up Implementational and Ideological Spaces in Heritage Language Education. The Modern Language Journal, 89(4), 605–609.

Levy, H.M. (2008) Meeting the needs of all students through differentiated instruction: Helping every child reach and exceed standards, Clearing House, 81(4), 161-164.

Lin, N. (1999) Building a Network Theory of Social Capital. Connections, 22, 28-51.

Manti, S, & Licari, A. (2018) How to obtain informed consent for research. Breathe (Sheff), 14(2),145-152. doi: 10.1183/20734735.001918.

Martin, B., Stewart, G., Watson, B.K., Silva, O.K., Teisina, J., Matapo, J. & Mika, C., (2020). Situating decolonisation: An indigenous dilemma. Educational Philosophy and Theory, 52(3), pp.312–321.

Mateus, S.G. (2014) Translanguaging: language, bilingualism, and education. Bilingual Research Journal, 37:3, 366-369 DOI: 10.1080/15235882.2014.965361

Nicolopoulo, K. (2022) What Is Purposive Sampling? | Definition & Examples.

Paradowski, M.B. (2010) The Benefits of Multilingualism. Warsaw: University of Warsaw.

Thomas, W.P. & Collier, V.P. (1998) Two languages are better than one. Educational Leadership 55(4), 2-26.

Velasco, P., & García, O. (2014) Translanguaging and the Writing of Bilingual Learners. Bilingual Research Journal, 37(1).

Li, W. (2011) Moment Analysis and Translanguaging Space: Discursive construction of identities by multilingual Chinese youth in Britain. Journal of Pragmatics, 43(5), 1222–1235.

William, C. (1994) An evaluation of teaching and learning methods in the context of

bilingual secondary education. Unpublished Doctoral Thesis. Bangor: University of Wales.

Yilmaz, T. (2019) Translanguaging as a pedagogy for equity of language minoritized students. International Journal of Multilingualism. 18. 1-20.

The usage of a simplified decoding approach to improve formula derivation in engineering programmes

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Abstract

In times of rapid technological innovation and global challenges, the development of Science, Technology, Engineering and Mathematics (STEM) competencies becomes important. Numerous intricate formula derivations are crucial skill-building exercises to improve students' learning activities in many engineering programmes. The majority of students lack the necessary mathematics background to completely understand some of those derivation procedures. However, as an engineering educator, we need to teach students these mathematical derivations to develop and build their mathematical thinking. In this work, a simplified three-step decoding of the derivation process is proposed to support explaining some of the mathematical derivations to develop and enhance students' cognitive and constructive learning. The lecture of “idealisation of thin-walled structures” under the Level 6 Aerospace curriculum study at University of Hertfordshire was taken as an example for illustration. The objective is to support students' learning and aid them in developing transferrable abilities that they can use to address other engineering issues. Students benefited from the activities in two ways: first, they comprehended the mathematical justifications for each step of the derivation, and second, their study time was cut down. This article aims to produce a critically reflective analysis of the proposed simplified decoding methodology which might be applied to other foundational mathematical skills that students across disciplines need to master.

Introduction and Backgrounds

Most Material Science and Engineering courses at higher education institutions involve complex formula derivation steps designed to improve students' analytical skills (Jaworski, 2008). Formula derivations are defined as “the process of obtaining, proving, or inferring a formula from a set of established, well-known principles” (Altıntaş and İlgün, 2017). Many engineering educators have advocated modifications to the way that mathematics and formulas are taught to engineers in the existing STEM curriculum. They seek to provide "*precise and straight-forward formalism and proofs*" to tailor for students' taste and exams. There are certain reasons behind that, for instance, Gries (Gries, 1995) noted that “students' reasoning abilities are poor, even after several math courses. Many students still fear math and notation, and the development of proofs remains a mystery to most.” Moreover, students are likely to engage in activities that feel worthwhile and relevant to their studies as a whole (Back *et al.*, 2008). For example, the prevalent curriculum strategy at the

Aerospace Engineering department at Herts is to divide courses "into areas of 'theory' and 'practice'" and it was discovered that students are more drawn to the practical courses and saw the analytical theories as separate and distinct. However, science does not revolve around being able to enter data into formulas. It has to do with being able to build new knowledge by beginning with what is already known. Therefore, being able to determine the necessary relations depending on your input is a crucial skill. It may be advantageous to take into account a broader definition of mathematics within engineering curriculum, namely *mathematical thinking*, according to work from the mathematics education community (Cardella, 2008).

Schoenfeld (Schoenfeld, 2016) describes mathematical thinking as not only involving the mathematics content knowledge we want engineering students to learn, but also problem-solving strategies, metacognitive processes, beliefs, affects and practices. To further clarify, problem-solving strategies include "decomposing and recombing" (Polya, 1965) and "guess and verify" (McGinn and Boote, 2009). A cyclic mathematic modelling, based on Blum and Leiss (Blum and Leiß, 2007), has been proposed to solve a problem in the real world. One can identify the following process: (1) understanding the situation in the real world (situation model), (2) making assumptions and simplifying the situation model (real model), (3) mathematising the real model (construction of a mathematical model), (4) working within the mathematical model (mathematical solution), (5) interpreting the solution, and (6) validating the interpreted solution – these steps in this process are shown as a representation in Fig. 1.

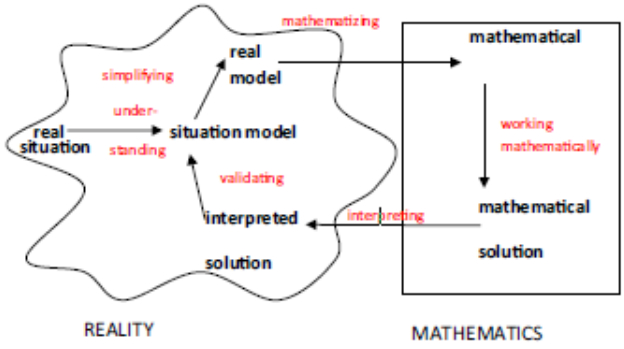


Figure 1. *An idealised scheme of the mathematical modelling used for problem-solving (Blum and Leiß, 2007)*

Overall, rather than passively absorbing information from the lecturer, students must actively participate and seek out answers to issues during their learning (Liu and Chen, 2010). Feedforward teaching styles require lecturers to give illustrative instructions that guide the learner towards the desired results (Basso and Olivetti Belardinelli, 2006), in those approaches, scaffolding practices might impact students' abilities negatively. In order to aid the students' learning, this study reflected additional phases/decoding to the derivation process. Based on the decoding the disciplines model (Middendorf and Pace, 2004a), this

work proposes a simplified three-step decoding model, a logic based approach to motivate and encourage students' conceptual thinking by promoting structural mathematical derivations found in the literature. Structured derivations promote preciseness of expression and straightforward presentation of mathematical reasoning, without restricting the application area. This will help deepen students' understanding and support them to acquire the necessary transferable mathematical problem-solving skills that can be applied in other engineering programmes.

The proposed approach

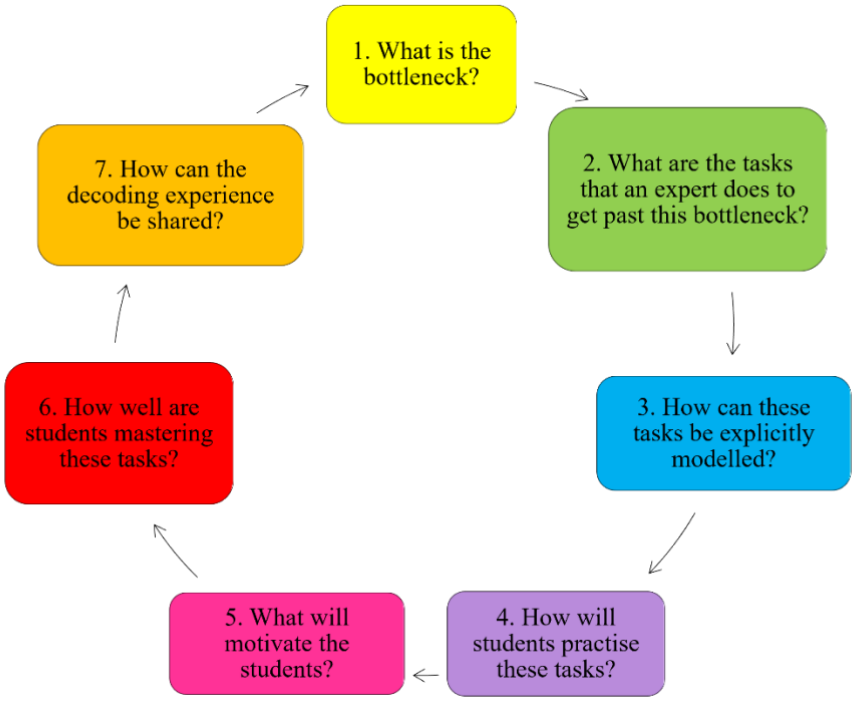
Here I propose a simplified approach involving the development of a framework for clarifying the original derivations by decoding each derivation steps to support lecturers' teaching and students' constructive and cognitive learning. The method, which is based on the theory of constraints (Goldratt and Cox, 2004) and the decoding the disciplines model (Middendorf and Pace, 2004), aims to broaden the theoretical underpinnings of the model in order to enable the identification, analysis, and removal of learning bottlenecks and constraints from a goal-oriented process improvement perspective. The modifications and decoding were illustrated on an example of "idealisation of thin-walled structure" taught in Level 6 Aerospace curriculum students. This module used to have a lot of analytical and derivate instructions and studies that were challenging for students to understand and apply. By decoding this example, the aim is to facilitate students' learning and help them acquire transferable skills when solving other engineering problems.

Middendorf and Pace's decoding the discipline model is shown in Figure 2(a), which is a seven-step process to create innovative learning interventions to overcome challenges in teaching and learning. Middendorf and Pace's model emphasises goal-oriented focus to guide the process of the learning improvement, however, I believe this is a bit complicated and has put a lot of emphasis on the "uncovering the bottleneck" step, so it is not effective to incorporate the above model into the derivation steps; as the derivation steps are more straightforward with clear learning achievements, therefore more should be focused on the learning interventions. Therefore, a simplified three-step decoding model is proposed to adjust the learning and delivering of a derivation learning process.

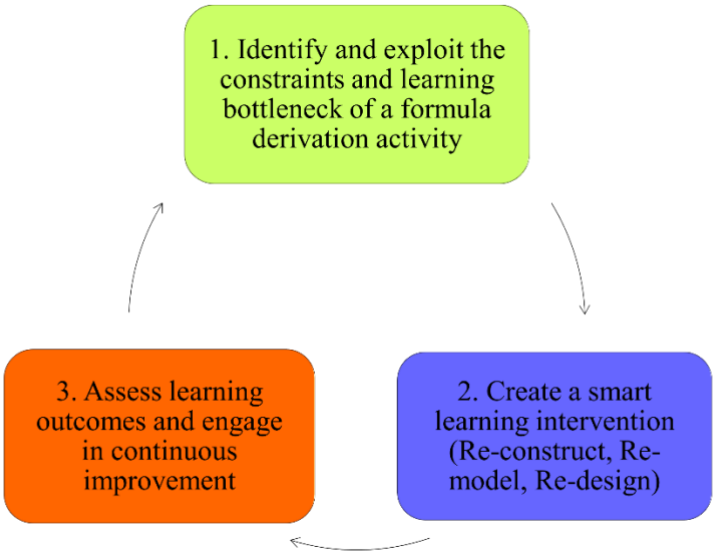
The three-step approach includes the following three steps, as shown in Figure 2(b):

- Step 1: Identify and exploit the constraints and learning bottleneck of a formular derivation activity
- Step 2: Create a smart learning intervention (Re-construct, Re-model, Re-design)
- Step 3: Assess learning outcomes and engage in continuous improvement

The three-step process will be thoroughly discussed along with an example from a lecture delivered in aerospace engineering curriculum.



(a) The decoding the disciplines model



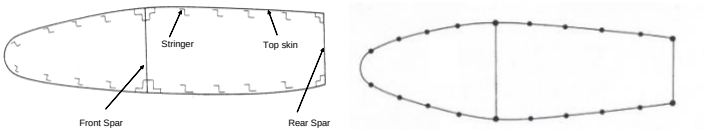
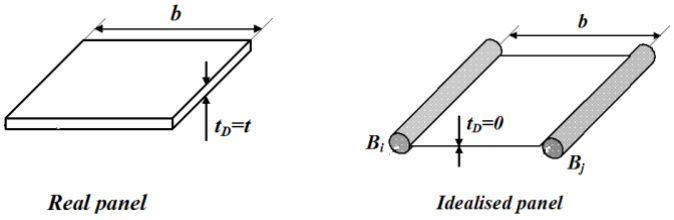
(b) The simplified decoding model in formular derivation activity

Figure 2. (*a) The decoding the disciplines model proposed by (Middendorf and Pace, 2004), (b) the proposed simplified decoding model incorporated in derivation steps*

Colour coding: The proposed decoding method begins with a step that combines detecting the learning bottleneck and outlining the actions to get beyond it (using a mix of yellow and green colours); The development of an efficient learning activity to get around the motivational bottleneck (using a combination of the colours blue and purple); and finally, evaluation of the students' learning (a mix colour of red and orange).

Table 1 illustrates the details of how to interpret the proposed simplified decoding approach in an aerospace engineering example of "idealisation of thin-walled structure" to motivate and build student confidence.

Table 1: *The proposed simplified decoding approach used in aerospace engineering curriculum (the teaching materials referred from (Liu, 2021))*

Proposed approach	**Example demonstration**
Step 1: Identify and exploit the constraints and learning bottlenect of a formular derivation activity	
1.1 Idealise the assumption behind the formular	The aim of this learning example is to idealise a thin-walled structure (with complex stringers and spars, left figure) into a concentrated structure with booms (right figure) to simplify stress analysis. Note: Equip students with problem-solving skills 
1.2 Coherent the learning goal	
1.3 Identify the learning task	To breakdown and define the problem by taking a zoomed region into each single problems (Note: Define the problem): 1) Define the real panel (left) taken into analysis 2) Define the idealised panel (right) taken into analysis  *Real panel* *Idealised panel* Note: Express the problem as a mathematical model that takes less steps for derivation
1.4 Identify the bottleneck	Realise that the formula derivations is hard to understand, due to normally two reasons: 1) students lack of mathematical knowledge; 2) students have a mistaken pre-conception that the derivation is hard to start and follow
1.5 Highlight and encourage the importance of the bottleneck	The formula derivation in step 1.3 is a fundamental model and helpful to the understanding of the problem

Step 2 Create a smart learning intervention (3Rs: Re-construct, Re-model and Re-design)	
2.1 Re-construct the derivation process as an expert	The learning task takes a small piece of panel into analysis, which switch the derivations of the original large, complex shaped geometry into a small, simple flat geometry. In that case, the students are much easier to accept from the start. Note: Choose the smart derivation blocks in mathematics to express the problem algebracially
2.2 Re-model the derivation approach from students' perspective	Break down the problems into smaller questions, thinking about the most acceptable derivation steps from students' perspective. Avoid going back and forward during the derivation steps, the quantitative derivation process should be in linguistics. Note: The building blocks for derivation are similar to those used in linguistics: split large problems into smaller ones while learning from these to larger ones logistically.
2.3 Re-design the tasks for students to practice	Create exercise questions after the derivation so the students can practice and enhance the knowledge. Illustrate the relevance of modelling from personal and professional applications.
Step 3: Assess the learning outcomes and engage in continuous development	
3.1 Establish checkpoints and provide feedbacks	The checkpoints can be embedded in homework, quizzes, assignments and exams if the derivation steps are proper understand.
3.2 Communate high expectations	Discuss the fun of mathematical thinking and the demand of numeracy skills.

The explanations of the proposed model are further detailed as follows:

1. I think the first challenge is the *affective bottleneck* (*Step 1*). Students frequently have the false belief that they just need to retain the final formula which can be applied right away (students regard solving an engineering problem as nothing more than putting numbers into a magic black box called a "model."). This, together with students' low self-efficacy in analytical skills, makes it difficult to maintain students' interest in studying the derivation components. Therefore, the first task for educators is to equip students with the usefulness of the subject matter through both the personal and problem-solving levels. In another way it appears to be to understand how to extend the model to represent more complex situations. For instance, evidence of the mathematical thinking and formula derivations in how to calculate dynamic loadings of a wing structure using Excel as a tool can be illustrated

to motivate the students to raise their numeracy competencies as well as to fitting for the strong demand of numeracy skills in the job market.

Once those constraints have been identified, one crucial step is to *idealise the assumptions* underlying the formular to be transmitted (*Step 1.1*), this is important as these assist in how to comprehend the gaps between the mathematical modelling and the practical modelling. For instance, in the example in Table 1, it is required to know that the simplify of complex add-ons of aircraft structures into booms is based on the assumption that the difference of the normal and shear stresses within those add-ons' structures are negligible.

Then the next bottleneck is to *determine a learning goal* (*Step 1.2*) to understand how the model is derived, and how to interpret the "answer" from the black box (*Step 1.3*). The learning tasks should be built logically to support students to build the numerical capability gradually, e.g., I discovered that it was simpler and more acceptable to students to break up a large derivation problem into multiple smaller questions, with each tiny question requiring the fewest steps possible. When the steps in the derivations are back and forward, the students frequently find it difficult to understand the questions, consequently, the logistically based formular derivations are crucial. With the designated designed learning tasks, we should additionally *locate the bottlenecks* (*Step 1.4*) during instructions where the students are struggling to comprehend the built-in derivation processes and motivate them by *emphasising the importance of the bottleneck* (*Step 1.5*), e.g., the derivation improves comprehension of the issue to prevent improper problem solving.

2. To get past the bottleneck, *a smart learning intervention* (*Step 2*) should be created based on the ideal of "Re-construct, Re-model and Re-design". The smart learning intervention refers to a terminology of "*structured derivations*" which means that the derivation steps suggested are '*re-constructed to model the expert's approach'* (*Step 2.1*), e.g., Darko (Darko, 2021) has added further mathematical steps to the original derivation steps in modern literature into Maxwell and the Voigt-Kelvin models for material science. It also indicates we should be responsible for giving clear, well-structured presentations and skilled at simplifying complex ideas. The structured derivations provide a well-defined proof format, which gives students a concrete model for what constitutes a proof and which can guide them in how to carry out rigorous proofs in practice (Back *et al.*, 2008). A clear and familiar defined format functions give students belief in their own skills to construct the proof. One thing to keep in mind is that the *re-modelling of the derivation process* (*Step 2.2*) could be applied similarly to linguistics, where selecting the appropriate mathematical building blocks (such as variables, constants, and operators) was like selecting the appropriate alphabets, words, and phrases in English to avoid confusing the students (Lee-Post, 2019). The students see this modelling process in action

during the entire course. Throughout the course, students will be given homework, tests, assignments, and exams to practise the process, which ranged from productivity analysis to linear programming optimisation (*Step 2.3*).

3. As with the cognitive bottleneck, Formative assessments, e.g., exam results and coursework assignments were used to *gauge the effectiveness of the planned intervention* (*Step 3*). We should clearly *communicate high expectations* (*Step 3.2*) based on the assessment of the knowledge, e.g., mastering the bottleneck task. All of their assessments (Exams or checkpoints) should include a derivation-building process evaluation. It is explicitly stated by (Lee-Post, 2019) that numerical answers "must be supported by evidence of how your answers were produced to receive partial credit." This serves as a reminder to students. If the derivation procedure was appropriately displayed beside the question, incorrect responses to multiple choice questions will still receive partial credit (*Step 3.1*).

Evaluation and Student Feedbacks

I evaluated the effectiveness of the proposed approach using both subjective and objective assessments. The above-example lecture was initially taught by myself when I joined UH from Semester B 2021/22, and it was totally redesigned from Semester A 2022/23 by myself, where structured derivations were introduced to put more focus on enhancing students' logical reasoning and proof-writing abilities in practice. The course was attended by 67 students in aerospace engineering at Semester B 2021/22 (Module code: 6ENT1035) and 64 students with same background at Semester A 2022/23 (Module code: 6ENT1167). The evaluation process includes 11 lectures (2 hours each), and one analytical assignment (Analytical Stressing Design Assignment, short for ASDA, both submitted as online report for Sems B 2021/22 and Sems A 2022/23). Pre- and post- course observations and feedbacks were used to evaluate the course and students' opinions about the approach. Students' assignment scores were used as a proxy measure for their actual learning in the objective assessment. Assignment scores were compared between classes with past students for a reference, it should be noted, though, that while the level of difficulty is the same, the assignment's substance differs owing to university requirements, however, the assignments are aiming for evaluating the same learning outcomes.

A simple and easy on-line survey was constructed in Mentimeter quiz and was distributed to the students in Semester A 2022/23 at the revision week (last for 10 minutes before the end of the lecture) to all attended students (45 out of 64 students in total). Students were required to answer four questions to indicate that their participation was voluntary and that results may be used to inform curriculum design and that the data may be made public, in line with UH guidance no Ethics approval was required. The four questions are listed below:

Q1 Do you understand and enjoy the mathematical derivations covered in this lecture?

- ○ Enjoy and able to understand (1)
- ○ Enjoy but not able to understand (2)
- ○ Not enjoy but able to understand (3)
- ○ Not enjoy and not able to understand (4)

Q2 Do you think the mathematical derivations covered in this lecture affect your study period?

- ○ Yes, increase my study time to understand the mathematical derivations (1)
- ○ No, reduce my study time as those are explained well in the class (2)

Q3 Would you suggest the lecturer covering the mathematical derivations in the future?

- ○ Yes (1)
- ○ No (2)

Q4 Please leave your comments/feedbacks to whether you find the modified derivation approach covered in the lecture helpful.

Feedback information gathered from the students were as follows, some students (25 out of 45) found the modified derivation approach interesting and useful, with some comments:

"The modified mathematical derivations steps enhanced my understanding"

"I struggled initially to make meaning of the derivation steps and found writing the derivations a bit tedious, but nevertheless found the derivating approach amazing"

“My learning hours for this unit was reduced throughout the semester because more clear in lecture”

The issues raised by the students mostly concerned the justifications and presumptions in evidence. One student (8 out of 45) also reported having trouble recalling the format's syntax.

“It seems a little pointless to drive everything.”

“I believe it is challenging to write down the motivations of doing these derivations.”

“It's challenging to tell when a derivation is accurate. What is reasonable to presume and what is not?”

In general, the students’ feedback can be summarised as follows:

● Understanding: More than 60% of the students revealed that the modified derivation steps helped clarify their misconceptions and made initially perceived complex derivation steps becoming less difficult. They are more accessible to apply fundamental mathematics to subject discipline examples.

● Study periods: Approximately 29 out of 45 students noted that adding additional teaching hours on the mathematical derivations’ steps reduced their learning hours after class if they can follow successfully during the lecture. They intend to be more engaged in the tutorial questions that follow the lesson. However, they still find some of the derivations boring and difficult to follow up.

I feel that the students’ feedback indicated that the majority of them did not have fear about the mathematical derivations anymore, even during their self-learning, which are encouraging findings. It's interesting to observe that students scored better (from an average of 42.9 to 53.8) in the assignment compared with past-year students (Figure 3), but the improvements only apply to simple derivations on comparably simple questions; they still received low marks for more complex derivations or they even give up answering. Based on this experience, some revisions were made before delivering this lecture again in Semester B 2022/23. The main adjustments were that, rather than using structured derivations on specific lecture topics, the method is now used at the beginning of this module to gradually build students' understanding, and that the derivations between various lecturers are linked with so that previous derivations can be remembered. The use of the structured derivations framework and the necessity of practising mathematical proof construction remain the main points of attention. My initial observations up to now show that students are now more aware of the course's objectives from the start and are using the structured derivations approach in their own solutions.

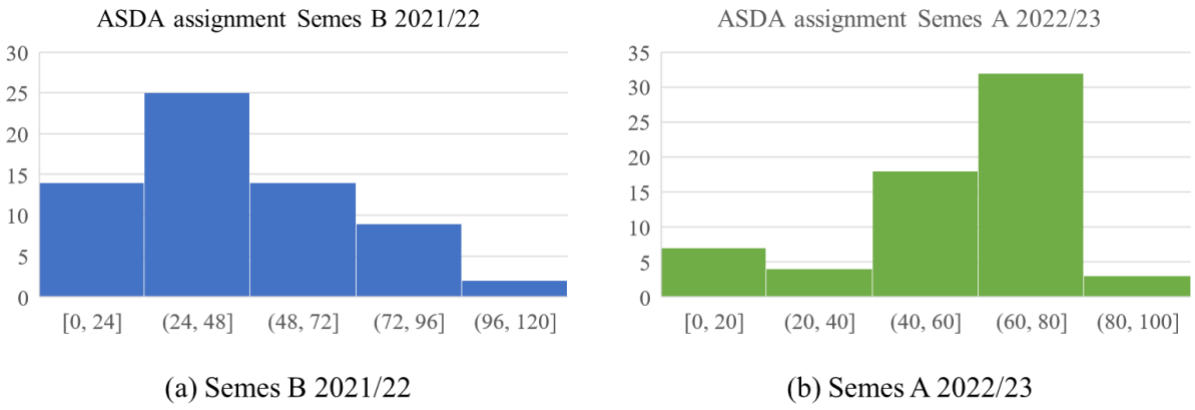


Figure 3. *The ASDA assignment score distributions: (a) Semes B 2021/22 and (b) Semes A 2022/23*

Reflective Analysis and Discussion

After evaluating the proposed decoding methodology, I set out to seek answers and reflects on the following two research questions:

- RQ1: What obstacles exist in the way of undergraduate students becoming more adept at solving mathematical problems?
- RQ2: How might undergraduate education improve students' ability to solve mathematical problems?

A short answer to these questions is that my proposed approach is effective in overcoming both cognitive and affective bottlenecks simutaneously to improve students' problem-solving skills towards a positive change in attitude towards the formula derivations.

Both theoretical and practical contributions are made by my investigation. In order to study the learning process and improve the theoretical underpinnings of the Decoding the Discipline model, the theory of constraints towards the formular derivation process has been extended. The resulting approach to learning improvement is more straightforward, understandable, and practical. In terms of practical contributions, the cognitive intervention is shown to improve students' ability to explain how to solve problems using quantitative modelling. Additionally, it has been demonstrated that the emotional intervention increases students' confidence in their ability to apply mathematics to solve problems correctly by increasing their sense of self-efficacy in this area.

However, the study includes a number of restrictions. Firstly, the suggested strategy was applied and evaluated in a single analytical course. The results should be viewed carefully in light of various courses and environments that require formular derivations, such as mathematical disciplane or non-physical fields like business. Secondly, the study's explanatory power is constrained since the analysis ignores variables that might have contributed to the change in skill level, such as concurrent enrollment in other courses. In

order to establish the survey instrument's reliability, additional validation beyond its initial validity is required for a longer period of time.

Conclusion

The method of supplementing decoding ideas in the original derivation processes found in engineering literature enhances students' learning without affecting their learning outcomes. This is crucial since it is impossible to enrol only students with strong mathematical backgrounds in engineering programmes, and these activities are great opportunities for weaker students to strengthen their mathematical foundation before entering the programme. The mathematical derivation stages must also be explained to the students by engineer lecturers so that the students understand how they were arrived at and where they fit within the "black box" in engineering curriculum. Considering the widening curriculums, the STEM at higher education institutions is greatly expanded when mathematical principles and engineering concepts are combined. This gives a platform for STEM activities to be developed among engineering students.

Therefore, a simplified three-step decoding of incorporating formular derivation steps into engineering lectures are proposed based on Step 1: Identify and exploit the constraints and learning bottleneck of a formula derivation activity; Step 2: Create a smart learning intervention (Re-construct, Re-model and Re-design); Step 3: Assess learning outcomes and engage in continuous improvement. The general strategies when using the proposed decoding approach are:

1. Reading through the derivation processes and stating the necessary mathematical principles;
2. Referencing outside mathematical and practical literature to support and encourage derivations;
3. Analysing the advantages of including essential mathematical derivation steps;
4. Building check points and effective assessment to monitor the learning of the derivations;
5. Transferring acquired knowledge in other engineering work.

The ongoing work will further look at exploiting the decoding process with other engineering lectures to get their feedbacks to promote deep students’ learning from wider engineering.

References

Altıntaş, E. and İlgün, Ş. (2017) 'Educational Research and Reviews Exploring the opinions about the concepts of "formula" and "rule" in mathematics', Academic Journals, 12(19), pp. 956–966.

Back, R.-J. et al. (2008) 'Structured Derivations: A Logic Based Approach to Teaching Mathematics', FORMED 2008: Formal Methods in Computer Science Education, Budapest, pp. 1–10.

Basso, D. and Olivetti Belardinelli, M. (2006) 'The role of the feedforward paradigm in cognitive psychology', Cognitive Processing, 7(2), pp. 73–88.

Blum, W. and Leiß, D. (2007) 'How do Students and Teachers Deal with Modelling Problems', In C. Haines, P. Galbraith, W. Blum, & S. Khan (Eds.), Mathematical modelling: Education, engineering and economics—ICTMA 12 (pp. 222–231). Chichester: Horwood., pp. 222–231.

Cardella, M.E. (2008) 'Which mathematics should we teach engineering students? An empirically grounded case for a broad notion of mathematical thinking', Teaching Mathematics and its Applications, 27(3), pp. 150–159.

Darko, C. (2021) 'The Use of STEM Approaches To Improve Formula Derivation Steps in Material Science and Engineering Programmes at Higher Education Institutions', European Scientific Journal ESJ, 17(29), pp. 38–58.

Goldratt, E.M. and Cox, J. (2004) The goal : a process of ongoing improvement. Great Barrington: North River Press.

Gries, D. (1995) 'Equational Logic as a Tool', In AMAST '95: Proceedings of the 4th International Conference on Algebraic Methodology and Software Technology, 936, pp. 1–17.

Jaworski, B. (2008) 'Helping engineers learn mathematics: A developmental research approach', Teaching Mathematics and its Applications, 27(3), pp. 160–166.

Lee-Post, A. (2019) 'Developing numeracy and problem-solving skills by overcoming learning bottlenecks', Journal of Applied Research in Higher Education, 11(3), pp. 398–414.

Liu, C.C. and Chen, I.J. (2010) ‘Evolution of constructivism. Contemporary issues in education research’, Contemporary Issues in Education Research (CIER), 3(4), pp. 63–66. .

Liu, Y. (2021) ‘Analytical Stressing Design Analysis 3 lecture notes’, University of Hertfordshire.

McGinn, M.K. and Boote, D.N. (2009) ‘A First-Person Perspective on Problem Solving in a History of Mathematics Course’, Mathematical Thinking and Learning, 5(1), pp. 71–107.

Middendorf, J. and Pace, D. (2004a) ‘Decoding the disciplines: A model for helping students learn disciplinary ways of thinking’, New Directions for Teaching and Learning, 2004(98), pp. 1–12.

Middendorf, J. and Pace, D. (2004b) ‘Decoding the disciplines: A model for helping students learn disciplinary ways of thinking’, New Directions for Teaching and Learning, 2004(98), pp. 1–12.

Polya, G. (1965) ‘How to solve it’, Princeton University Press [Preprint].

Sazhin, S.S. (1998) ‘Teaching mathematics to engineering students’, International Journal of Engineering Education, 14(2), pp. 145–152.

Schoenfeld, A.H. (2016) ‘Learning to Think Mathematically: Problem Solving, Metacognition, and Sense Making in Mathematics (Reprint)’, Journal of Education, 196(2), pp. 1–38.

Decoding Adaptive Teaching; Teacher Educator Challenges

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Abstract

Teacher Educators employ a range of pedagogical approaches, often drawing on their teaching experiences, to decode professional practice for student teachers. As practice evolves, the expertise held by teacher educators may no longer reflect current expectations set out by professional bodies. Drawing on a focus group interview, this study investigated the experiences of two teacher educators supporting student teachers through the learning bottleneck of unpicking the theoretical and practical applications of inclusive pedagogy as embodied in the terminology of Adaptive Teaching. The findings highlight the challenges faced by teacher educators and have implications for professional development priorities.

Introduction

Supporting student teachers' professional development may be seen as the primary role of teacher educators (Lunenberg et al., 2014), with some discussion focusing on the journey from novice to expert (Berliner, 2001; Kennedy, 2016). While common features of teaching expertise have been defined (Berliner, 2001), the context-specific nature of what is thought of as 'acceptable' (Alexander, 2001) or 'fashionable' (Kennedy, 2016) means that these may be subjective and changeable. Part of the challenge may be the interplay between the complex and invisible knowledge held by expert teachers (Loughran & Menter, 2019) and the resultant observable impact on their classroom practice. Student teachers often hold naïve assumptions about what teaching involves, based on their own experiences as students (Kennedy, 2016; McConn & Geeter, 2020) which may be further reinforced if faced with a discrepancy between the approaches advocated for within their university studies and the realities present in some schools (Lunenberg et al., 2007; McConn and Geeter, 2020). As such, the challenge for teacher educators may be seen as multi-layered in that they must de-mystify the ways of thinking (White, 2009) that underpin more tangible aspect of what teachers 'do' and the 'moves' they make in the moment (Kennedy, 2016). Without a clear understanding of the why of a particular approach, there may be distortions in the application of theory to practice on the part of novice teachers (Ghousseini, 2015). Enabling student teachers to make meaningful connections between theory and practice may thus be seen as a key task for teacher educators.

For teacher educators seeking to support student teachers to secure threshold concepts (Meyer and Land, 2003) that demarcate the difference between novice and expert ways of thinking and acting in the classroom, a potentially promising approach may be found in the decoding the disciplines framework (Middendorf & Pace, 2004). By explicitly highlighting

common pedagogical bottlenecks, and uncovering the mental processes involved in problem-solving, this approach may enable teacher educators to reveal what may otherwise be invisible to student teachers (Loughran & Berry, 2005; Loughran, 2006; White, 2009). Indeed, engaging students in making connections between the everyday problems they experience in the classroom with specific bodies of knowledge and practices has been shown to be effective in raising student achievement (Kennedy, 2016). The decoding the disciplines framework further makes real the everyday experiences of the classroom through modelling within taught sessions; something that has been identified as a desirable professional competency of teacher educators (Korthagen et al., 2006; Loughran & Berry, 2005; Montenegro, 2020).

The challenge of making truly effective connections between theory and teaching practice has been widely discussed (Loughran & Berry, 2005; Lunenberg et al., 2007; White, 2009) with some (Hogg & Yates, 2013; Loughran, 2006; Lunenberg et al., 2007) highlighting that modelling without explicit articulation of the underpinning theory and thought processes may be insufficient in moving student teachers beyond a superficial level of understanding. In engaging student teachers in complex meta learning (Loughran & Berry, 2005) about teaching and learning, teacher educators may fall back on their own experiences in the classroom to effectively engage in talking aloud and debriefing teaching (Loughran & Berry, 2005) to 'reveal the thought bubble' (White, 2009:487) behind their observable actions. As such, some parallels may be drawn between commonly recognised teacher educator competencies and decoding the disciplines framework (Middendorf & Pace, 2004), highlighting the potential for its application within teacher education.

Whilst the decoding the disciplines framework (Middendorf & Pace, 2004) may offer a practical methodology for teacher educators seeking to support students to overcome troublesome threshold concepts (Meyer & Land, 2003), the successful application of this approach is rooted in the notion that the educator holds the position of 'expert' in their levels of confidence and competence in relation to the 'novice' student (Kennedy, 2016; Middendorf & Pace, 2004). In the ever-evolving landscape of teacher education, notions of what is considered to be good practice, outlined, and enforced by relevant professional bodies, is subject to ongoing change (DfE, 2021), meaning that the expertise held by teacher educators may no longer be considered to be current or reflective of the accepted evidence base (Lunenberg et al., 2007). Indeed, Lunenberg et al. (2007) highlight the range of practical challenges faced by teacher educators in dedicating time and energy to developing their professional knowledge and practice as key role models for student teachers. They further suggest that teacher educators may not always possess the knowledge and skills required for effective modelling that explicitly links theory and practice. Given the importance placed on being able to do so (Hogg & Yates, 2013; Loughran, 2006; Lunenberg et al., 2007) in a way that is meaningful to learners' current levels of understanding (Land et al., 2014), the importance of ensuring that teacher educators are truly able to think, feel and act as experts emerges as foundational to effective teacher education.

Within the context of Initial Teacher Training (ITT) in England, recent years have heralded some considerable change to established policy and practice. The ITT Core Content Framework (Department for Education (DfE), 2019a) and Early Career Framework (DfE, 2019b) set out the entitlement for a structured package of support for students engaged in initial teacher training and completing their probationary period as Early Careers Teachers. Accredited (DfE, 2022a) providers of initial teacher education must ensure that their curricula encompass the full entitlement described in the ITT Core Content Framework, with the expectation that they will integrate 'additional analysis and critique of theory, research and expert practice as they deem appropriate' (DfE, 2019:4). In the context of the ITT market review (DfE, 2022b), the stakes for providers of Initial Teacher Education could scarcely be higher (UCET, 2022; Walker, 2022), with far-reaching implications for both livelihoods of teacher educators and future teacher supply. As such, ensuring that teacher educators have the ability and confidence to act as agents of change (Lunenberg et al., 2007; Montenegro, 2020), decoding the disciplinary knowledge and professional practice outlined within the ITT CCF may arguably be seen as a matter of high importance for ITT providers.

This small-scale study focuses on an aspect of professional awareness and practice that is commonly recognised (Florian & Spratt, 2013; Florian, 2019; Sharma et al, 2008) as challenging for both novice and expert teachers, and which has been the subject of research and debate within teacher education (Booth et al., 2003; Florian & Rouse, 2009); that of developing an inclusive approach to education. Underpinning current local (DfE, 2019a) and international (European Agency for Special Needs and Inclusive Education (EASNIE), 2022) definitions of inclusive education is the idea that educators should 'rethink difference as a feature of all learners and diversity as an opportunity for all' (EASNIE, 2022:12). This builds on rights-based, anti-discriminatory models; rejecting deficit views of difference and deterministic beliefs about learner ability (Florian & Rouse, 2009) and viewing inclusive practices as beneficial for everyone (Florian, 2019; Hart et al., 2007). Encouraging a mindset of broadening what is generally available within the classroom whilst simultaneously adopting a curious and inquiring approach to learning about individual differences (Florian & Black-Hawkins; 2011; Mulholland, 2022) is recognised as reducing the often-cited feelings of a lack of competence and confidence in meeting diverse learner needs (Florian & Black-Hawkins, 2011; Sharma et al., 2008) among new teachers. Arguably, supporting student teachers to develop a meaningful understanding of inclusive education may be seen as a 'jewel in the curriculum' (Land et al., 2014) that is capable of transforming student understanding of their role as a teacher (Florian & Rouse, 2009); meeting the definition of a threshold concept (Meyer & Land, 2003) and presenting a common bottleneck (Middendorf & Pace, 2004) to learning.

Rights-based principles of inclusive education now form a key part of the minimum entitlement for Initial Teacher Training in England, embodied in the term 'Adaptive Teaching' (DfE, 2019a). However, this relatively recent shift means that traditional

approaches to accommodating diversity - rooted in deficit ways of viewing difference - arguably remain deeply embedded within the wider education system (Florian, 2019). As such, a multi-layered potential problem emerges within teacher education. Firstly, if the body of knowledge imparted by teacher educators does not reflect the practice witnessed by student teachers in schools, they may fall back on comfortable, familiar ways of thinking (Middendorf & Shopkow, 2018) about learner differences. If teacher educators are to enable students to develop a critical stance on their observations without simply criticising the practice they witness (Florian & Rouse, 2009) or falling back on deterministic assumptions about student ability, they must engage in the complex task of decoding the mental processes underpinning different practices (Loughran & Berry, 2005), with the decoding the disciplines methodology offering a potential framework to do so. However, a secondary complication to this process may arise if teacher educators are no longer able to rely on their existing experiences and expertise due to changes in policy and practice, meaning that they could find themselves at the very same bottleneck as the student teacher.

This article reports the results of a small-scale study exploring the views of two teacher educators on their experiences of teaching students about inclusive educational practice as embodied within the terminology of Adaptive Teaching (DfE, 2019a). The first three steps of the Decoding the Disciplines framework formed the basis for thematic analysis to explore how well-equipped participants felt in supporting student teachers to overcome this potential bottleneck in their learning:

(1) Identify a bottleneck to learning

(2) Uncover the mental tasks needed to overcome the bottleneck

(3) Model these tasks

(Decoding the Disciplines, 2022; Middendorf & Pace, 2004)

The study aimed to provide initial insights into the challenges faced by teacher educators in effectively decoding inclusive practice for student teachers, potentially highlighting implications for professional development priorities and acting as an impetus for further study.

Methodology

Research Question

The following research question guided the focus of the study:

Do Teacher Educators feel equipped to overcome student bottlenecks to developing effective Adaptive Teaching?

Design

This applied study sought to provide initial insights about potential barriers to teacher educator application of decoding (Middendorf & Pace, 2004) aspects of inclusive practice as understood within the terminology of Adaptive Teaching (DfE, 2019a). As such, the goal was to obtain different perspectives on the chosen topic (Gibbs, 1997) and to generate information that could support the development of effective future practice (O'Leary, 2004) through the use of a focus group interview (Barbour, 2008).

Participants

Participants were handpicked (O'Leary, 2004) to meet the criteria of having shared key experiences (Barbour, 2008; Breen, 2007) including those of being teacher educators with long-standing experience of teaching on modules concerned with pedagogy more generally and specifically with inclusive educational practices. It was hoped that this would facilitate open discussion about potentially challenging topics (Barbour, 2008). Some practical issues led to the sample being significantly reduced, with the final group being made up of only two participants, well-below the number typically recognised as ideal for focus group interviews (UCL, 2022).

Materials

A focus interview schedule (Breen, 2007) was constructed to provide an overarching structure with some flexibility in allowing participants to direct the discussion and the researcher playing the part of moderator. A provisional coding frame was developed and later revised to include subcodes (Barbour, 2008).

Procedure, including ethical considerations: Participants were invited to attend an online, recorded focus group interview. Prior to the focus group, participants were sent information about both practical and ethical aspects of the research (Breen, 2007). This information was restated upon participants arrival alongside ground rules for the session. The focus group interview lasted 30 minutes, following the general structure of the interview schedule, with some flexibility to allow for a more natural discussion. The recording was transcribed following the session, with all responses being anonymised, removing any information that could allow the participant or student group(s) to be identified.

The work was part of ordinary curriculum development with the principal beneficiaries being current or future students and staff. As such, the study was covered by UH Protocol for Reflective Practitioner Work by Academic Staff (University of Hertfordshire Higher Education Corporation, 2018).

Data Analysis

Thematic analysis (Barbour, 2008; O'Leary, 2004) of the transcript was carried out. Initially, a deductive search explored responses relating to three key themes derived from the Decoding the Disciplines framework: (1) Define the bottleneck, (2) Uncover the mental processes and (3) Model the task (Middendorf & Pace, 2004). It was necessary to be mindful of any potential unconscious bias and tendency to 'fit' the data to the categories (O'Leary, 2004). As such, further inductive analysis was utilised to maximise chances of reaching meaningful conclusions (O'Leary, 2004), identifying emerging themes and leading to the development of subcategories both within and beyond the three key themes.

Limitations

The subjectivity of the researcher must be acknowledged as a potentially influential factor on all aspects of methodological design and interpretation of the 'big ideas' (Krueger, 2002) within the data. From the outset, the researcher's very presence as well as the nature of the questions doubtless triggered particular responses (Krueger, 2002) and may have further impacted the validity of the findings.

While no assumptions can be made about the generalisability of the views of the sample (O'Leary, 2004), the findings may provide initial insights on a local level and spur on further research to explore whether the views expressed are representative of a wider sample of teacher educators.

Findings

Student bottleneck issues

The participants identified Adaptive Teaching as an area that student teachers commonly find difficult, identifying several contributary factors. When discussing student understanding of inclusive practice, participants overwhelmingly focused on the challenges posed by differential messaging at university and during their school-based training, with this issue mentioned on nine occasions during the focus group interview, as illustrated in Figure 1.

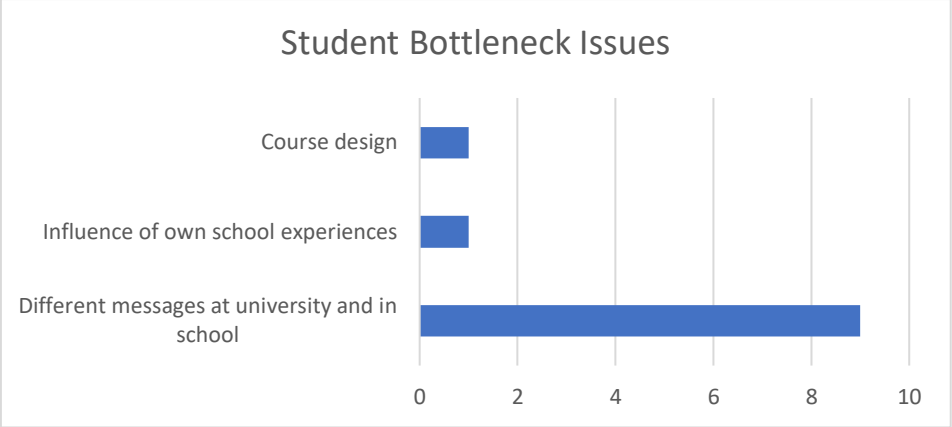

Figure 1*: Student bottleneck issues identified by participants by number of mentions during focus group interview.*

Secondary bottleneck issues

Despite demonstrating a clear understanding of the ideas underpinning Adaptive Teaching as an aspect of pedagogy, the comments in Table 1 indicated that the teacher educators in this study did not feel the same level of confidence in teaching students about this area as they would usually feel in relation to their own subject specialism.

Table 1*: Comments relating to confidence about teaching about adaptive practice*

Confidence in teaching about adaptive practice	
'I think I think for me is it is one of the areas I feel least confident teaching. I don't really know why. I think it's because it has changed so much. And you do rely on…on thinking about what you used to do.'	*'I think I feel less confident about talking about it and supporting the students…you know, I'll talk about but it's not one of those things where I go - Oh yeah, great! I can talk about this one - I feel confident.'*

The participants identified a number of secondary bottleneck issues that they were facing themselves as seen in Table 2. Of these, changes to practice were mentioned significantly more than any of the other issues.

***Table 2**: Secondary challenges to practice identified by participants.*

Secondary Bottleneck Issues			
Changes to practice since own time in the classroom	Less time to research concepts than own subject specialism	Lack of access to practical resources	Not knowing students well

Responses appeared to indicate that these issues impacted on participants' feelings of confidence in enacting the second stage of the decoding the disciplines framework, that is: unpicking the values, models, and specialist 'mental processes' (Middendorf & Pace, 2004) underpinning inclusive practice. This may be illustrated within the excerpts from the transcript in Table 3.

***Table 3**: Excerpts from the transcript relating to Step 2 - Uncovering the mental tasks needed to overcome the bottleneck for student teachers.*

Step 2: Uncovering the mental task	
'I don't feel confident in my own knowledge of these things to be able to effectively do it….I think it's really hard and I don't feel very confident doing it. No, I don't feel anywhere near as confident as I do in terms of [name of subject specialism]. If somebody was talking to me about a [subject specific] lesson, I could, I feel like - Oh yeah, I've got the confidence there. I could do it. I don't feel I could do it in terms of adaptive practice.'	*'…I'd be tiptoeing around it slightly …. I'm trying to tease more out of the student and try and make links, but not feel as confident as I would as if it was subject knowledge.* *If it was…somebody talking about [subject specific] lesson … I think I'd ask better questions as well. I don't if I'm asking the right questions sometimes.'*

The participants also reported challenges with the third step in the decoding the disciplines framework – that of 'modelling tasks' within taught sessions. In particular, the participants highlighted that although they could apply general principles of inclusive practice with the aim of making sessions more generally accessible, they faced difficulties in enacting truly responsive 'adaptive' teaching without knowing individual students well (Table 4).

Table 4: *Excerpts from the transcript relating to Step 3 - Model these tasks*

Step 3: Modelling the task	
'I think I'm absolutely hopeless at that … there are some things that I try now to put into everything [recounted an example related to accessibility] … Much beyond that and thinking about 'this is a good way to get these ideas across'. Like really general, you know, trying to think of this sort of quality first teaching…Beyond that, I find the…the real difficulty is when you compare what you used to do when you had your class and you knew those children inside out [provided examples]. In the sessions we do, I don't know the students, so I can do it from the point of view of really general things.'	Talking about a group they teach regularly: *'…you know the ones where you're going to have to keep them on track. They're likely to have a chat about something or they're going to struggle to actually engage and read something because they might just need some prompting on that…but those are the those are the groups that I have had regularly, and I know quite well individually. The other groups, you just pick up.'*

Potential ways forward

Interestingly, considering that the discussion highlighted a secondary bottleneck experienced by the participants, they also highlighted the value of working alongside '*expert colleagues*' (DfE, 2019a) themselves to see real examples of adaptive teaching in schools or to hear this being unpicked with student teachers in sessions. At times, comments focused on the value of these experiences in revealing the relevance of their own past practice:

'…did I adapt my practice? Yes, we actually did but we didn't articulate it in that way'.

Both participants suggested that these same issues may impact on school-based mentors who may also benefit from access to further training and support.

Having access to video clips of effective adaptive teaching in action was described as 'gold dust' by one participant as they highlighted the challenges in trying to unpick student recounts of practice they had seen in school.

Discussion

This study explored whether the teacher educators involved felt equipped to overcome student bottlenecks to developing inclusive educational practice. Overall, the findings suggested that for the two teacher educators who took part, this was not the case. In fact, both participants identified this as an area where they felt they lacked their usual levels of confidence in their own expertise, impacting on their ability to unpick the unseen 'thought bubble' (White, 2009), and to provide what they considered to be effective modelling of the tasks involved. Although the underlying reasons for these findings appeared to be multifaceted, the overarching reason given appeared to be rooted in the relatively recent changes to professional expectations around inclusive pedagogy, meaning that they felt less able to make use of their own past classroom experiences in their current teaching about Adaptive Teaching. As such, the most significant finding of this study was that the secondary bottleneck experienced by the teacher educators appeared to impact on their perceptions of their own ability to enact the second and third steps of the decoding the disciplines process (Middendorf & Pace, 2004).

The results of this study provide further support for the widely recognised idea (Florian and Spratt, 2013; Florian, 2019; Sharma et al., 2008) that inclusive practice may be considered to constitute a common area of challenge - or bottleneck (Middendorf & Pace, 2004) - in the learning and professional development of student teachers. The secondary finding that teacher educators themselves may find themselves at this same bottleneck may be significant considering the key role they play in supporting the meta learning of student teachers (Loughran & Berry, 2005; Loughran & Menter, 2019), particularly within the context of a changing teacher education landscape (DfE, 2022b). Interestingly, although the participants demonstrated a clear understanding of Adaptive Teaching as a pedagogical approach and were able to articulate a range of ways in which they modelled aspects of Adaptive Teaching in their own daily practice - albeit within some identified practical constraints - neither participant positioned themselves as an 'expert colleague' (DfE, 2019a). In fact, both participants engaged in extensive critique of their own ability to support students with areas of confusion and compared themselves unfavourably to their former classroom teacher selves. These results highlight the need to firstly explore whether this lack of confidence is more widespread than this initial small sample, and secondly to consider how best to ensure that teacher educators feel equipped to support student teachers through all aspects of their professional learning journey.

Some interesting directions for professional development priorities were highlighted during the focus group interview. Of particular note was the fact that several of the participants' ideas about what they would find helpful can be considered to correspond to the first three steps of the decoding the disciplines methodology (Middendorf & Pace, 2004), suggesting that this model may have applications as a framework for ongoing professional development in addition to supporting student learning. Indeed, the participants' discussion

about the impact of working closely with colleagues with expertise in enacting inclusive pedagogy to deepen their own understanding the practical applications of theory, as well as the usefulness of having access to video clips to do the same for student teachers, are not unreasonable aspirations for training providers with established links to local partnership schools. As such, the application of the decoding process as a professional development tool appears to warrant some further exploration.

The importance of ensuring that faculty are well-equipped to meet the challenges of working within ever-evolving professional fields, such as education, cannot be overstated. As professional practice changes, consideration must be given to the steps required to ensure that tutors are able to not only identify bottlenecks in student learning, but confidently decode these aspects of professional practice in order to support students on their journey from novice to expert. If developing a meaningful understanding of Adaptive Teaching is accepted as a threshold concept (Meyer & Land, 2003) within teacher education, then teacher educators must be provided with the requisite tools to effectively gauge student understanding (Land et al., 2014) and enable them to engage in transformational learning opportunities (McConn & Geetter, 2020) with far-reaching implications for their future pupils and the wider educational system.

References

Alexander, R. (2001). Culture and pedagogy: International comparisons in primary education. Malden, MA: Blackwell.

Barbour, R. S. (2008) Doing Focus Groups, London: SAGE Publications.

Berliner, D. C. (2001) 'Learning about and learning from expert teachers'. International Journal of Educational Research, 35, pp. 463-482.

Booth, T., Nes, K. & Stromstad (eds) (2003) Developing inclusive teacher education: Reforming teacher education, London: Taylor & Francis Group.

Breen, R. L. (2006)' A Practical Guide to Focus-Group Research', Journal of Geography in Higher Education, 30 (3), pp. 463-475, DOI: 10.1080/03098260600927575

Decoding the Disciplines (2022) Decoding the Disciplines Wheel.

DfE (2019a) ITT Core Content Framework.

DfE (2019b) Early Career Framework.

DfE (2021) Proposals to drive up training standards for teachers.

DfE (2022a) Accredited initial teacher training (ITT) providers.

DfE (2022) Policy Paper: Initial Teacher Training (ITT) Market Review: Overview.

European Agency for Special Needs and Inclusive Education (2022) Profile for Inclusive Teacher Professional Learning.

Florian, L. & Rouse, M (2009) 'The inclusive practice project in Scotland: Teacher education for inclusive education.' Teaching and Teacher Education, 25, pp.594–601.

Florian, L. & Black-Hawkins, K. (2011) 'Exploring Inclusive Pedagogy'. British Educational Research Journal, 37 (5), pp.813-828.

Florian, L. & Spratt, J. (2013) 'Enacting inclusion: a framework for interrogating inclusive practice', European Journal of Special Needs Education, 28(2), pp.119-135.

Florian, L. (2019) 'On the necessary co-existence of special and inclusive education', International Journal of Inclusive Education, 23 (7-8), pp.691-704.

Ghousseini, H. (2015) 'Core practices and problems of practice in learning to lead class discussions'. Elementary School Journal, 115(3), pp. 334-357.

Gibbs, A. (1997) 'Focus Groups. Social Research Update'. University of Surrey.

Hart, S., Drummond, M. & McIntyre, D. (2007). 'Learning without limits'. In The Sage handbook of special education, Edited by: L. Florian 499– 514. London: Sage.

Hogg, L. & Yates, A. (2013) 'Walking the Talk in Initial Teacher Education: Making Teacher Educator Modeling Effective', Studying Teacher Education, 9 (3), pp.311-328.

Kennedy, M. (2016) ‘Parsing the practice of teaching’. Journal of Teacher Education, 67 (1), pp6-17

Korthagen, F., Loughran, J. & Russell, T. (2006) ‘Developing fundamental principles for teacher education programs and practices’, Teaching and Teacher Education, 22 (8), pp.1020-1041.

Krueger, R. A. (2002) Designing and Conducting Focus Group Interviews.

Land, R., Rattray, J. & Vivian, P. (2014) ‘Learning in the liminal space: a semiotic approach to threshold concepts’, Higher Education, 67 (2).

Loughran, J. & Berry, A. (2005) ‘Modelling by teacher educators’, Teaching and Teacher Education, 21 (2), pp. 193-203.

Loughran, J. (2006) Developing a pedagogy of teacher education: understanding teaching and learning about teaching. London: Routledge.

Loughran, J. & Menter, I. (2019) ‘The essence of being a teacher educator and why it matters’, Asia-Pacific Journal of Teacher Education, 47(3), pp.216-229.

Lunenberg, M., Korthagen, F. & Swennen, A. (2007) ‘The teacher educator as a role model’, Teaching and Teacher Education, 23 (5), pp. 586-601.

Lunenberg, M., Dengerink, J., & Korthagen, F. (2014) The Professional Teacher Educator: Roles, Behaviour, and Professional Development of Teacher Educators, Boston: BRILL.

McConn, M. L., & Geetter, D. (2020). ‘Liminal States of Disorienting Dilemmas: Two Case Studies of English Teacher Candidates’. Journal of Transformative Education, 18(3), pp.231–250.

Meyer, J.H.F. & Land, R. (2003). 'Threshold concepts and troublesome knowledge: Linkages to ways of thinking and practising within the disciplines', in Rust, C. (ed.), Improving Student Learning: Improving Student Learning Theory and Practice-Ten Years On. Oxford: Oxford Centre for Staff and Learning Development.

Middendorf, J. & Pace, D. (2004), Decoding the disciplines: A model for helping students learn disciplinary ways of thinking. New Directions for Teaching and Learning, 98, pp. 1-12.

Middendorf, J. & Shopkow, L. (2018) Overcoming Student Learning Bottlenecks : Decode the Critical Thinking of Your Discipline, Stylus Publishing, LLC.

Montenegro, H. (2020) ‘Teacher educators’ conceptions of modeling: A phenomenographic study’, Teaching and Teacher Education, 94.

Mullholland, M. (2022) ‘Think like a detective: The vital clue to inclusive teaching!’ Bera Blog.

O’Leary, Z. (2004) The Essential Guide to Doing Research, London: Sage.

Sharma, U., Forlin, C. & Loreman, R. (2008) ‘Impact of training on pre-service teachers' attitudes and concerns about inclusive education and sentiments about persons with disabilities’, Disability & Society, 23 (7), pp.773-785.

UCET (2022) UCET's statement on the outcomes of Round 1, Stage 2 of the Market Review.

UCL (2022) Focus Groups.

University of Hertfordshire Higher Education Corporation (2018) Protocol for Reflective Practitioner Work by Academic Staff. Studies Involving the Use of Human Participants – Protocol for Reflective Practitioner Work by Academic Staff. Version 09.0, Appendix I, UPR RE01. University of Hertfordshire.

Walker, A. (2022) ‘ITT review: DfE rejects all accreditation appeals’. Schools Week.

White, E. (2011) ‘Working towards explicit modelling: experiences of a new teacher educator’, Professional Development in Education, 37 (4), pp.483-497.

The value of groupwork in developing professionalism in undergraduate paediatric nursing students

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Abstract

With consideration of current teaching methods and pedagogic theories this paper aims to explore the research topic of the value of group work in developing professionalism in undergraduate paediatric nursing students. During the progression of paediatric nursing students undergraduate training programme, the students are learning to become healthcare professionals in accordance with the Nursing and Midwifery Council (NMC). The present nursing curriculum is split into fifty percent academics and fifty percent practical, because of this divide the academic setting has been given the reputation of being focused on assessments. Whereas the practical setting is focused on developing clinical skills. Due to professionalism being assessed in the clinical setting engagement in teaching, activities like group work which aim to teach, develop, enhance, and allow students to practice professionalism are not always seen and utilised as an effective tool. By carrying out an in-depth literature review this paper aimed to identify key themes associated with this topic. Themes found included professionalism, the hidden curriculum, collaboration, and group work. From the review of these topics' recommendations such as:

- Working in partnership with students to review and redesign the academic setting and perception of being assessment focused.
- Clear communication of the professional traits that aim to be developed through group work.
- Exploring how to model and communicate professionalism for students to embody in their professional identity.
- Consider further research into this area of topic.

have been suggested to continue to improve the effectiveness in teaching professionalism by using group work in the academic setting.

Introduction

Upon qualification a graduate paediatric nurse is expected to be a professional. This is an expectation outlined by the University of Hertfordshire graduate outcomes (2022), and the NMC code of conduct (2018). The NMC states that nurses being professional is of high importance and it also outlines that nurses must be able to work co-operatively with a range of professionals (NMC, 2018). The current nursing curriculum (NMC, 2019) is fifty percent academic and fifty percent practical learning. The current challenge faced by the learners

within the academic environment of undergraduate nurses is the increased emphasis of professionalism within the practical elements of their undergraduate training programme. There is a tendency for undergraduate nursing students to academically focus on passing their assignments, with little acknowledgement of teaching frameworks used academically to develop their professional identity. Groupwork is a common activity used within the undergraduate nursing programme as this allows the students to learn, practice and reflect. Group work utilises Thomas and May's (2010) framework of inclusive learning and teaching in higher education and is useful when considering group work. The framework highlights the emphasis on collaborative learning and the focus on student-centred pedagogies which encourages student engagement and therefore student success. Group work is also used based on the pedagogic theory of Vygotsky (1978), social constructivism of knowledge being developed through interaction and communication with others allowing students with varying prior knowledge to share their experiences with each other. This is important in group work because it encourages opportunities for students' voices and opinions to be shared and heard.

However, Burke (2011) highlighted that although there are positives within the active learning style and social constructivism of group work such as greater resources, creativity, student awareness of self and teamwork, disadvantages also exist within group work: conflict may arise, and learners may not want to confront the conflict causing them to conform to pressure from within the group (Burke, 2011). Learners may experience that members within their team do not participate or contribute very little within the team. Another disadvantage is that co-ordinating group work takes more time then when learners work as an individual. Often the undergraduate nursing students focus on the negatives of groupwork. Especially if the learner has previously had a negative experience of group work, this experience may have occurred prior to learning at higher education (Burke, 2011). Higher Education Academy (HEA) groupwork (2014) also highlights that learners see groupwork as a task rather than a range of skills they are developing. This can potentially reduce the undergraduate nursing student's engagement in this learning activity. Therefore, reducing the development of their professional identity within the academic setting.

Currently at the University of Hertfordshire, undergraduate paediatric nurses at level 4 and level 6 undertake a module entitled 'Enhancing Health and Social Care Through Inter-professional Education Also Known as IPE'. This module focuses on the role of inter-professional working within the health setting and incorporates a range of undergraduate healthcare students. This module is incorporated to build the theoretical understanding of working co-operatively with others and developing the student's professional identity. Through activities encouraging students to work together within this module, it helps students to focus on working together in the academic setting and how this learning experience can be applied to the practical learning environment. However, outside of this module do students value the experience that group work activities present in developing their ability to collaborate and build upon their professional identity?

Professionalism is a complex and broad topic (Rudberg et al, 2022), and through a critical review of the available literature this article aims to investigate the value of using group work to build and develop professional identities and professionalism within undergraduate nursing students.

Background

Delivering patient centred care is the upmost priority to every healthcare professional. This is where the patient is at the core focus of every care plan, decision, and delivery of care. Patient centred care was outlined in the NHS 2000 plan (Department of Health, 2000) which stated that the NHS services needed to be shaped around the needs of individual patients and their families. The NMC the governing body for both nursing and midwifery was developed in 2002 (Nursing and Midwifery Order, 2001). Through this governing body the code of conduct was developed, this code outlines what is expected of all qualified nurses and midwives. The knowledge of this code of conduct has been shared to the public, thus shaping their expectations to the care and treatment they will receive by nurses and midwives. Professionalism is of such high importance that there is a section within the current code of conduct entitled Professionalism and Trust (NMC, 2018). Through the development of this code of conduct, professionalism is seen by the nurses and midwives abiding by and following this code. Alongside the NMC code of conduct and public expectation, graduate outcomes from the University of Hertfordshire state that each graduate will be professionally focused, formal, and work to a high standard. Again, providing a clear emphasis that the graduate will be professional (2022).

Currently within the University of Hertfordshire professionalism is assessed through students practice assessment document (PAD). This then causes there to be an emphasis on behaving professionally in practice when students are actively implementing and abiding by the code of conduct. However, student's professional identity begins before their first placement in the academic environment. Although as Biggs and Tang (2011) outline, within the academic setting undergraduate students' focus is on getting through the assessments as opposed to the learning that is being provided. Therefore, highlighting a bottle neck within the current method of teaching of how can students be encouraged to retain learning to build and develop their professional identity outside of the practical placement?

Presently the inclusive learning and teaching (Thomas & May,2010) and social constructivism (Vygotsky, 1978) frameworks are used for the application of group work activities within the academic environment to further shape professionalism by encouraging the students to work co-operatively with each other. These frameworks also help to foster characteristics found in the University of Hertfordshire Graduate Attributes (2022) that state that upon graduation that everyone will be able to work co-operatively with others. This is also an expectation of the NMC code of conduct as there is an expectation that qualified nurses and midwives can work as part of a multidisciplinary team to communicate and share information in the best interest of the patient. This is a concept taught within

undergraduate student's clinical practice module further building emphasis on developing professional skills for clinical practice. Therefore, is there a need to rethink how professionalism is taught? And is there a difference between being a professional student at the University of Hertfordshire versus being a professional in the clinical setting of placement?

Overview of Literature Search

With knowledge of the importance of professionalism within the nursing career, interest was sparked into teaching methods like group work used to facilitate the development of professional traits. An in-depth literature review of both academic and nursing journals was carried out. The initial search focused on professionalism, understanding the makeup of professionalism according to the NMC code of conduct (2018) and the undergraduate paediatric nursing students understanding of professionalism. The results returned many articles however, these articles focused on both paediatric nursing students and other undergraduate healthcare students experience of professionalism in the practical placement environment and how practical clinical placement experiences shaped the student's views and behaviours of professionalism.

These results were anticipated due to experience in both the clinical and academic environments. Where it has been observed that the emphasis of professionalism is based on student's practical experience and their ability to pass the placement successfully through completion of their PAD.

The search was narrowed by focusing on the academic environment of the university focusing on the use of group work and the effectiveness this teaching method had on aiding students to learn, practice, and utilise skills that will develop their professional identity. Although the search was narrowed to focus and be specific on the use of group work and how it translated to the student's understanding of its relevance and importance in developing their professionalism. From this literature search it became evident that there was a lack of literature on this topic.

Key Findings

Professionalism

Professionalism is a complex and broad topic within the nursing and healthcare setting (Mohamed, Dorgham and Eid, 2019). There was limited literature found when searching for the undergraduate nursing student's understanding of professionalism within the academic setting, which identifies that there is a gap for this research to be undertaken to gain further understanding of the current undergraduate nursing student's experience to be able to enhance teaching methods used to bridge the gap and further develop the student's professional identity whilst in the academic setting.

Kelly (2020) research highlighted that the development of student nurses' professional identity prepared students to challenge unethical behaviour when in practice as opposed to learning behaviours that they shouldn't. This is important to encourage nurses to graduate being able to follow up to date and evidence-based practice to provide good quality care. (Rudberg, et al 2022). However, Criggy and Godfrey (2014) research suggests that there is now a focus on professionalism being superficial because undergraduate students are focusing on it being a set of rules outlined by their governing body. Rather than a life-long skill that develops throughout their career including things like character, ethics, integrity, compassion, and social behaviours. Bimray, Jooste and Julie (2019) research also correlated with Criggy and Godfrey (2014) where they found that the students memorised the professional code in order to pass an assessment. Although this took place Bimray, Jooste and Julie (2019) concluded that professionalism was needed to be taught beyond a set of rules as there is a high expectation that all qualified nurses will be professional upon qualification.

Hidden curriculum

Within the literature search there was evidence that professionalism and how professionalism is taught in the theoretical environment is considered to be part of a hidden curriculum (Kelly 2019). The hidden curriculum refers to the idea that there are things being taught that there is an expectation on the students' learning that has been embedded within taught lessons. However, it has not been explicitly communicated to the students, this can include behaviours, values, attitudes, and norms that exist in the learning environment (Alsubaie, 2015). This can lead undergraduate paediatric student nurses to build a concept of professionalism however, they may not understand the importance of professionalism as it is implied and not explicit until they gain more experience within their undergraduate programme (Rudberg et al, 2022).

Bimray, Jooste and Julie (2019) research highlighted that depending on the academic level and experience of the undergraduate nursing student that professional values were often seen to be target orientated and learnt to pass assessments. However, Abbaspour et al (2022) literature highlighted that undergraduate paediatric nursing students were able to develop their professional identity through nurse educators role modelling professional behaviours, communications and 'story telling' of their nursing experience within the hidden curriculum. This alongside agreed code of conduct within learning environments further aided the development of the learners move along their journey of being novices to becoming experts in professionalism. However, Poorchangizi et al (2019) research suggest that there needs to be more explicit emphasis on professionalism within the undergraduate nursing program to reduce gap between the theory and practice of professionalism.

Collaboration and Professionalism

There was a lot of literature around the importance of collaboration in particular collaboration between different professions in developing professionalism. The World Health Organization (WHO, 1988) promotes IPE in supporting good quality interprofessional working to improve competence among healthcare professionals leading to better patient outcomes. IPE is an academic module which aims for students to develop an understanding of professionalism through communication, working together and sharing ideas (Kirkha,2021). Olson and Bialocerkowski (2014) highlights that through IPE the undergraduate students can explore, develop, and practice their professional identity by learning to not pass judgement, listen, communicate, problem-solve, and learn from each other. As everyone brings different characteristics such as cultural, economic, and social backgrounds as well as a differing views from different professions. The concept of IPE is to prepare healthcare students in accordance with their various code of conducts and for the expectations of multidisciplinary working that is expected in the healthcare setting (Yu et al, 2020 & Palese et al, 2019). However, Tran, Kaila and Salminen (2018) highlighted that barriers can occur with IPE and developing the undergraduate healthcare student's professional identity highlighting that at the beginning of their training the students may not have enough understanding of their profession to be able to implement professional attributes and see how they can draw upon the knowledge of their colleagues within other professions.

Group work

Wong (2018) research supports that group work is effective in enhancing student learning by developing student's collaborative skills in a professional manner outlined by agreed classroom rules. Although the research supports that group work is an effective teaching method, barriers were identified that impacted the effectiveness of group work. These factors included the formation of the group, group sizing, time allocated to the task and the frequency of group work allocated. Wong's (2018) results highlighted that excessive use of group work lowered nursing students' motivation, engagement in the activity, and overall satisfaction with their learning. Another piece of literature that stood out was Nuuyoma (2017). Nuuyoma (2017) agreed with Wong (2018) about the effectiveness of group work in developing nursing students' professional identity by co-operatively working together. Nuuyoma also identified similar barriers to Wong. However, Nuuyoma's (2017) research concluded that engagement of nursing students in group work was greater when the group was assessed, either as a formative or summative assessment where the group was given feedback or a grade. This further proves Biggs and Tang (2011) viewpoint that within the academic setting undergraduate students' focus is on passing assessments rather than the learning opportunities presented. Both Wong and Nuuyoma concluded that more research was needed to gain more insight into student nurses' viewpoint of group work throughout their degree programme.

Recommendations / Conclusion

From the exploration of this in-depth literature review it is evident that there are bottle necks present within the current teaching method of using group work to teach professionalism academically to undergraduate paediatric nursing students. Recommendations to review and address these include:

- To review and redistribute the message of focusing on professionalism in the clinical practice setting and IPE module. To encourage students to embody and see the academic setting as an environment in which students are there to do more than remember key information in order to pass their assessments. This may cause for the decolonising of the academic setting of the reputation that it is an environment solely focused on assignments. The recommendation would be for nurse educators to work with students and their student body representatives to redesign the academic learning environment to further support the teaching of learning to students.

- Ensuring that professionalism and professional traits that aim to be taught, explored, and developed through group work are explicit to the students - this can be incorporated into learning aims and objectives. Through this clear and open communication, it highlights to the students the importance of such activity and will potentially improve engagement. There should also be consideration into the frequency of such activity as Wong (2018) highlighted excessive use of this teaching activity was less effective.

- To consider exploring how to model, communicate and teach students to embody professionalism and their professional identity. Focusing on the academic setting to understand professionalism as more than a concept to remember.

- To consider further research into this area of topic using the concept of research rich (Bage, 2017) to improve educational practice to review and possibly change or adapt the current teaching methods used when applying group work to activities. To overcome barriers that reduce the effectiveness of the development of undergraduate students' professional identity further research should be carried out. The research method recommended would be qualitative data of interviews and questionnaires for Level 4, 5 and 6 undergraduate paediatric nursing students and newly qualified paediatric nurses of the University of Hertfordshire.

  This research would provide a comparison of data that would capture the student journey from novice to expert and identify any gaps between student professionalism and qualified professionalism. The questions would need to focus on the students understanding and knowledge of professionalism, how they view group work, what would cause them to engage in group work more and skills they perceive that they

develop through group work. It would also be interesting to clarify if, without the same emphasis of collaboratively working as the current IPE module, do the students consider group work a professional task towards collaborating and do they feel group work activities prepare them to work professionally with others? This method of research is supported by (Felten and Lambert, 2020) who encourage students to have influence in shaping and improving their learning and the learning environments for their peers. By capturing the student voice and their experiences can help to shape continued improvement within this area of study.

From continued research the development of professionalism in undergraduate nursing students within the academic setting with the use of group work can be enhanced to further improve professionalism among students in line with the University of Hertfordshire attributes and the NMC code of conduct preparing the students for success upon qualification and bridging the gap between students becoming professional paediatric nurses.

To conclude, professionalism is a broad topic that is of high importance within the undergraduate student nurse education. Group work can be effective activity to help develop skills to build a student nurses professional identity. However, through an in-depth literature review there is evidence for more research to be carried out to capture both undergraduate and qualified paediatric nurses' viewpoint to challenge and overcome these bottle necks to increase the learning of professionalism academically throughout more modules other than IPE and when in the clinical practice setting. This will challenge and change the way nurse educators teach professionalism with the hope to improve the development of undergraduate paediatric students' professionalism.

References

Alsubaie, A. M. (2015) 'Hidden Curriculum as One of Current Issue of Curriculum'. *Journal of Education and Practice.* 6(33).

Bage, G. (2017) *Looking to the future. Research rich and informed teaching.* University of Hertfordshire.

Biggs, J. & Tang, C. (2011) *Teaching and Quality Learning at University.* 4th revised and expanded edn. Maidenhead: Open University Press and McGraw-Hill Education

Bimray, P., Jooste, K. & Julie, H. (2019) 'Professionalism experiences of undergraduate learner nurses during their 4-year training programme at Higher Education Institution in Western Cape, South Africa'. *Curationis.* 42(1).

Bryan, C. (2015) *Enhancing Learning and Teaching in Higher Education: Engaging with the Dimensions of Practice*. Open University Press and McGraw-Hill Education

Burke, A. (2011) 'Group Work: How to Use Groups Effectively'. *The Journal of Effective Teaching.* 11(2) pp. 87-95.

Department of Health (2000) *The NHS Plan: a plan for investment, a plan for reform.*

Felten, P. & Lambert, M. L. (2020) *Relationship-Rich Education. How Human Connections Drive Success in College.* Maryland: John Hopkins University Press

Higher Education Academy (2014) *Group Work.*

Kelly, H. S. (2019) 'The hidden curriculum: Undergraduate nursing student's perspectives of socialization and professionalism'. *Nursing Ethics.* 27(5).

Kelly, H. S. (2020) 'The Hidden Curriculum: Undergraduate nursing students' perspectives of socialization and professionalism'. *Nursing Ethics.* 27(5) pp. 1250-1260.

Kirkham, L. (2021) 'Providing interprofessional education for pre and post-registration nurses'. *Nursing Standard.* 38(1).

Mohamed, K, L, Dorgham, R. S. & Eid, M. W. (2020) 'Experiences of Professionalism Attributes among Undergraduates Nursing Students and Nurses'. *Evidence Based Nursing Research.* 2(1).

Nursing and Midwifery Council (2018) *The Code.*

Nursing and Midwifery Council (2019) *Standards framework for nursing and midwifery education.*

Nursing and Midwifery Order 2001.

Nuuyoma, V. (2017) 'The Group-based Assessment Approach in Nursing Education: The Perspective of Nursing Students on Group-based Assessment Process at a Namibian University'. *International journal of Higher Education.*6(3).

Olson, R. & Bialocerkowski, A. (2014) 'Interprofessional education in allied health: a systematic review'. *Medical Education.* 48(3) pp. 236-246.

Palese, A., Gonella, S., Brugnolli, A., Mansutti, I., Saiani, L., Terzoni, S., Destrebecq, A., Zannini, L., Grassetti, L. & Dimonte, V. (2019) 'Nursing students' interprofessional educational experiences in the clinical context: findings from an Italian cross-sectional study'. *BMJ Open.*

Poorchangizi, B., Borhani, F., Abbaszadeh, A., Mirzaee, M. & Farokhzadian, J. (2019) 'Professional Values of Nurses and Nursing Students: a comparative study'. *BMC Medical Education.* 19(438).

Rudberg, L. S., Westerbotn, M., Sormunen, T., Scheja, M. & Lachmann, H. (2022) 'Undergraduate nursing students' experiences of becoming a professional nurse: a longitudinal study'. *BMC Nursing.* 21(219).

Thomas, L. & May, H. (2010) *Inclusive learning and teaching in higher education.* The Higher Education Academy.

Tran, C., Kaila, P. & Salminen H (2018) 'Conditions for interprofessional education for students in primary healthcare: a qualitative study'. *BMC Medical Education.* 18(122).

University of Hertfordshire (2022) *Graduate Attributes.*

Vygotsky, L. S. (1978) *Mind in Society.* Cambridge: Harvard University Press

Wong, F. M. F. (2018) ‘A phenomenological research study: Perspectives of student learning through small group work between undergraduate nursing students and educators’. *Nurse Education Today.* 68 pp.153-158.

World Health Organization (1988) ‘Learning Together to Work Together for Health’.

Yu, J., Lee, W., Kim, M., Choi, S., Lee, S., Kim, S., Jung, Y., Kwak, D., Jung, H., Lee, S., Lee, Y., Hyun, S., Kim, S. & Lee, J. (2020) ‘Effectiveness of simulation-based interprofessional education for medical and nursing students in South Korea: a pre-post survey’. *BMC Medical Education.* 20(476).

Breaking the Bias: Insights and strategies for addressing the gender gap in Engineering

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Abstract

Despite the significant progress on occupational gender equality over the last couple of decades and the enhanced creativity and innovation that workplace gender balance is known to yield, Engineering is still perceived as a male-dominated industry. Female engineering students and professionals are outnumbered by their male counterparts both in academic and professional environments, with even fewer females making it to the top of the professional ladder. This study undertakes a detailed literature review to quantify the extent of this phenomenon internationally, nationally, and locally at the University of Hertfordshire. A critical analysis is undertaken to understand the context and root causes of the problem and to identify potential approaches that may be used to alleviate this by looking at best practice elsewhere. It is found that the disparity is a result of a mixture of stereotypes, gender discrimination, social influence and expectations, lack of sense of belonging, and unequal or inflexible opportunities. Strategies to improve gender parity are proposed in this study and focus on three distinct levels, in schools, Universities and the work environment.

Introduction

Engineering is tantamount with solving real world problems using maths, science and ingenuity and is closely associated with growth and development. It typically involves designing, building, and testing structures, materials, or systems to provide solutions to technical problems. However, Engineering has been historically perceived as a male dominated industry. Despite the significant progress in workforce gender balance, Engineering lags behind other industries. In 2021, female representation in the UK's total workforce was 47.7%, indicating general gender parity, however, engineering core occupations (e.g., manufacturing, construction and information and communications industries) scored a woeful 15.2% in female representation (Engineering UK, 2022). Underrepresentation of women in Engineering, not only emanates from lack of female recruitment in the discipline but is also related to retention during their academic studies or career (McWhinnie & Peters, 2017).

Workforce representation should reflect our society. Gender balance in the workplace supports the formation of an inclusive environment and brings diversity of thought and multi-perspectivity. However, this is not only about social justice. A core part of Engineering evolves around problem solving. The way of approaching a problem is directly associated with experience and background. Therefore, the lack of female representation limits

perspective to males and hinders innovation and creativity. Additionally, gender diverse companies have a considerably higher likelihood of increased performance, profitability and value creation compared to their male dominated competitors (Gaines, 2017; Hunt et al., 2018). Hence why is Engineering still trailing behind other industries?

The aim of this study is to raise awareness of the gender gap in Engineering and to propose potential strategies for alleviating this. In detail, this study will shed light in three distinct fronts:

a) to quantify the extent of gender disparity at the University of Hertfordshire and at national and international levels;

b) to identify the underlying reasons behind gender disparity, as root causes need to be unveiled before interventions can be proposed and;

c) to propose potential strategies that could be adopted to improve gender balance in Engineering.

Method

This article is a review study and entails an in-depth literature review at the three aforementioned fronts. Sources used in this study, are compiled from electronic databases of peer-reviewed literature, including Scopus and Google Scholar, but also involve published research and data from independent and governmental organisations. Journal publication date is limited to the past 15 years (with very few exceptions) to ensure that the collected information is up-to date and still applicable. Data specific to the University of Hertfordshire is collected, using the Tableau Server (2022), to provide insights of gender balance in our Engineering School. Information is processed and evaluated, statistical analysis is undertaken in Excel where necessary, and results are portrayed in tabulated or schematic form via Excel or Microsoft Visio where relevant, to facilitate interpretation. Best practice of educational strategies is explored and the potential to transfer it across to Engineering is critically discussed.

Female representation in Engineering

According to the European Union statistical office (Eurostat, 2022), female engineers in EU comprised 43.4% of the total engineering population in 2021. This is a mean value for 31 countries with a coefficient of variation of 14.5%. Despite the fair performance on gender parity in the EU, the United Kingdom has one of the lowest scores in female engineering professionals in the continent. Female representation in the UK was only 15% in 2021 for engineering professions while an improvement of 6.7% was observed over the past decade (Figure 1, EngineeringUK, 2022). Unsurprisingly, similar percentages were found in Engineering at Universities, with only 1 female in 5 entrants in 2018, whilst the overall female population comprised 57.2% of the total student population in the same year (Figure

1). Although the percentage of female entrants in Engineering improved by 4.8% since 2010, predictions show that gender parity will not be achieved until after 2050, if the current improvement rate is maintained (EngineeringUK, 2020).

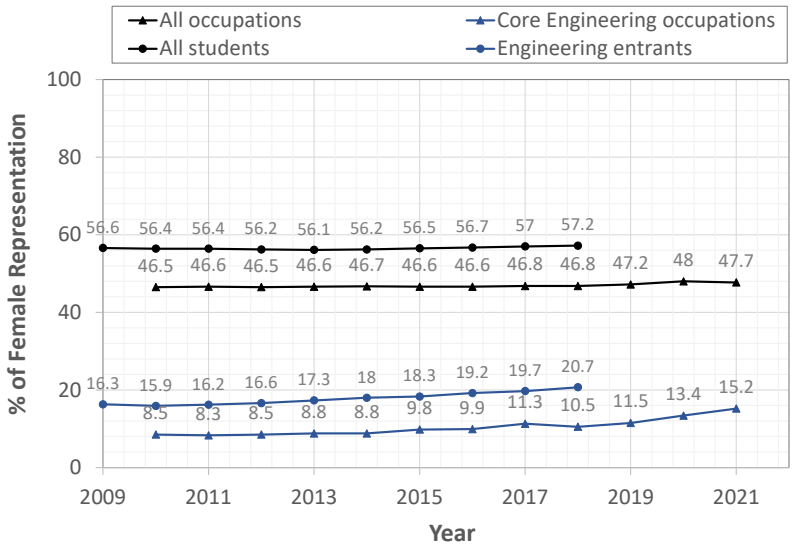

Figure 1*: Female representation of workforce / student populations in Engineering and; total workforce / student population, based on EngineeringUK, (2020, 2022) data.*

Data collected from the University of Hertfordshire (Tableau Server, 2022) confirm these observations showing a more pessimistic trend (**Figure 2**). In 2018, female students in Engineering accounted only for 11% of the total student population at the University of Hertfordshire, which is well below the national average (20.7%). Over the next 4 years, no noticeable improvement was observed in female representation. Looking at individual programmes, Aerospace, Civil and Electrical Engineering lead the way, although are still below the national average, while Mechanical and Automotive Engineering and Robotics have the lowest scores.

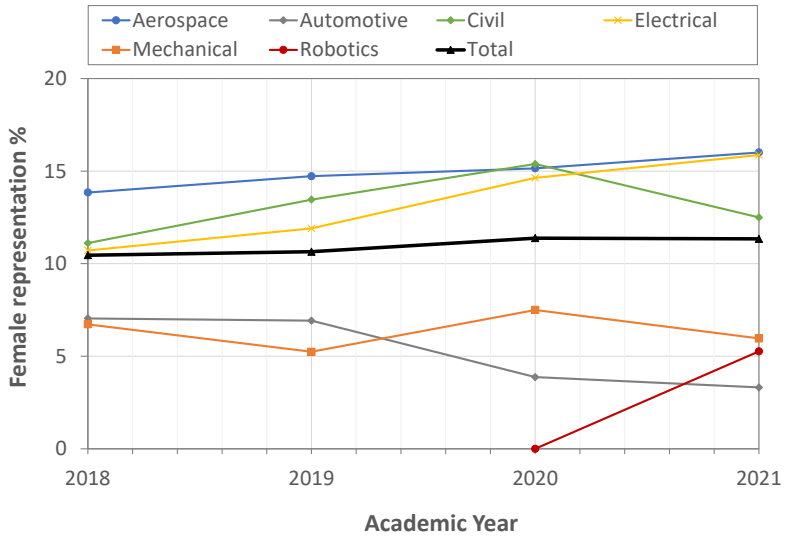

Figure 2*: Female representation in undergraduate Engineering students per programme at the University of Hertfordshire, based on Tableau Server (2022) data.*

Internationally, representation of women in Engineering is controversial. A study undertaken by the Royal Academy of Engineering, (2016) shows that the high economic growth of developed countries, does not automatically reflect gender balance in Engineering. This study ranked 100 countries in terms of Engineering Index (EI), an indicator of Engineering strength considering the quality of infrastructure and employment, salary, number of businesses and capital investment in Engineering. Developing countries such as Vietnam, Myanmar, Honduras, and Malaysia with very low EI, scored the highest in gender balance for engineering graduates. On the contrary leaders in EI including Denmark, Sweden, Netherlands, and Germany had lower and inconclusive gender balance scores of 73%, 56% 32% and 71% respectively. World map results, generated in Excel, are available in **Figure 3**.

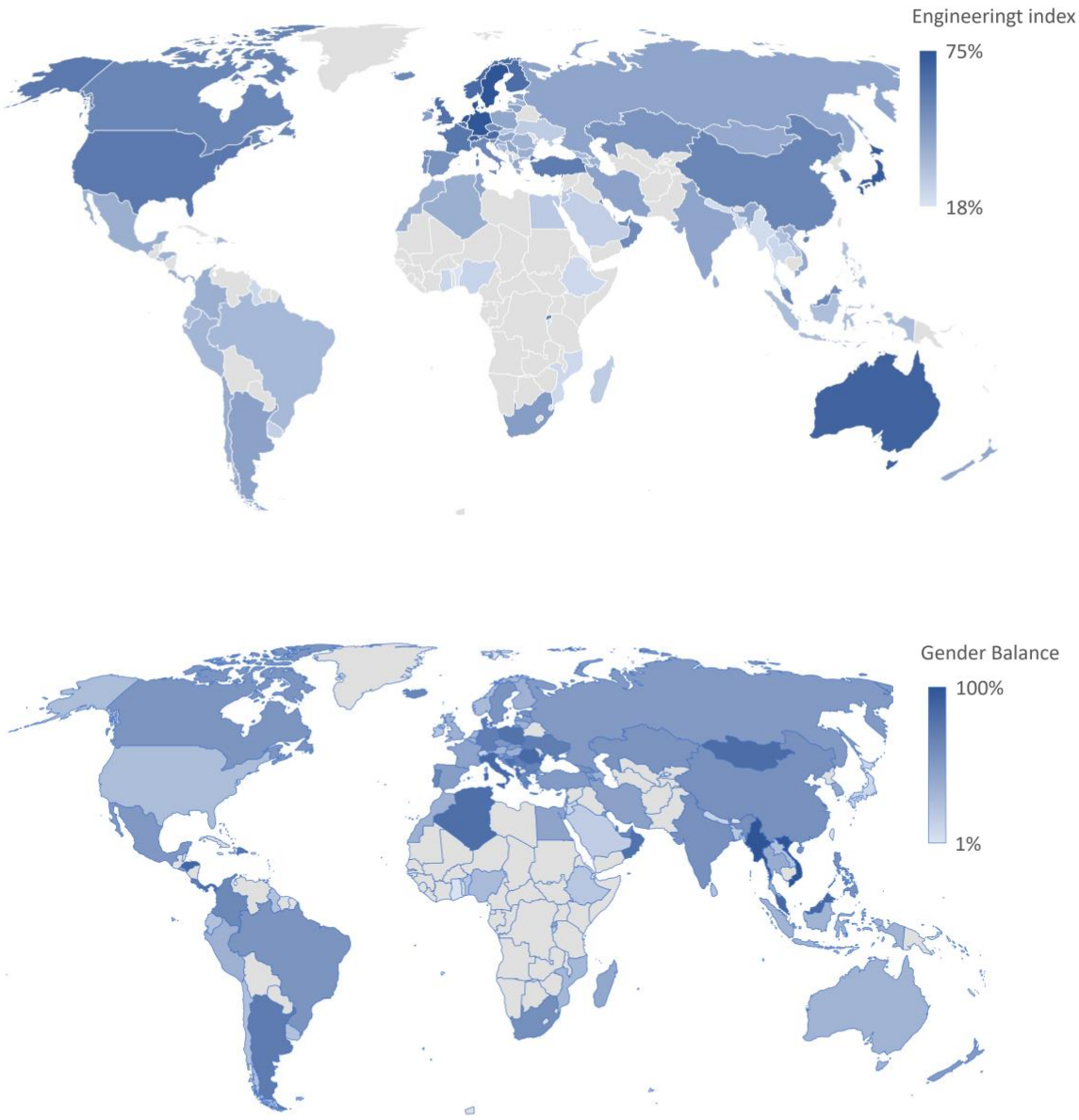

Figure 3*: Engineering Index (top) and gender balance in engineering (bottom) across the world, based on Royal Academy of Engineering, (2016) data.*

These results are unexpected since western developed countries scored very highly in Global Gender Gap Index in the World Economic Forum (2022) study compared to their developing counterparts, that fell in the lower part of the list. This therefore demonstrates a gender equality paradox as gender equality in Engineering does not correlate to overall gender equality in a country. According to Stoet & Geary (2018), this might be related to the lack of career variety for women from countries with low gender equality indices compared to gender equal countries and therefore well-paying careers in Science, Technology, Engineering and Mathematic (STEM) disciplines become more appealing to the female population.

Root causes of gender disparity in Engineering

The underlying causes of the gender disparity in Engineering are complex and multifaceted (***Figure 4***). They can be divided in female recruitment in Engineering Higher Education and female retention in Engineering professionals.

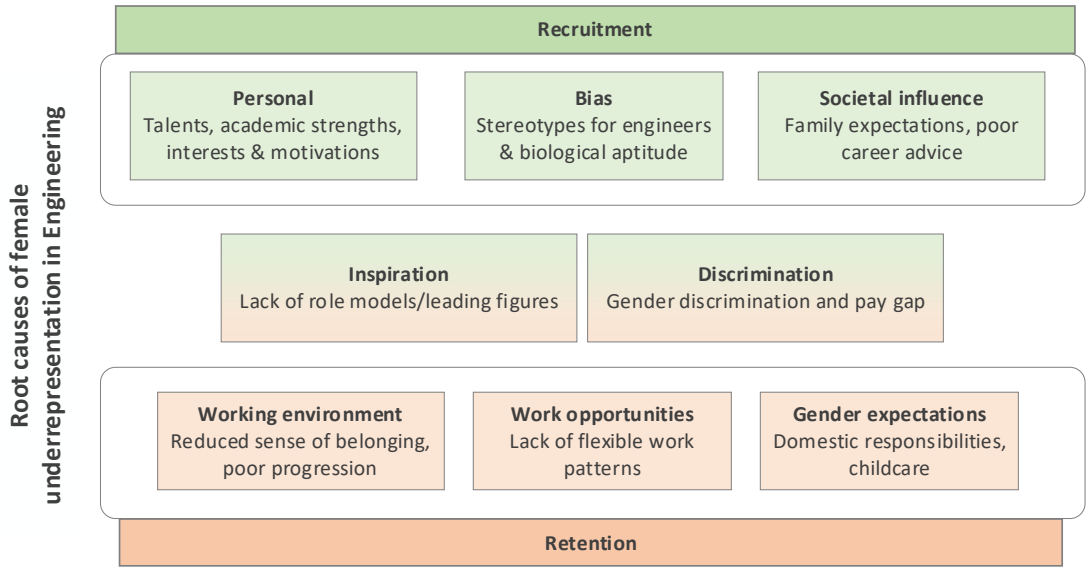

Figure 4*: Causes of gender disparity in Engineering (created in Microsoft Visio).*

Perhaps the most prominent cause is gender bias and stereotypes. Even nowadays, when people think of an engineer, deeply rooted notions of a man with a hard hat and a high visibility jacket holding design drawings, spring to mind. Even though career selection is based on personal interests, circumstances, and talents, it quickly becomes evident that this portrait is not welcoming for a young girl considering to study Engineering. The sense of belonging is right away challenged. In fact, previous research has shown that situational cues in gender-unbalanced environments can lead to identity threat, vigilance, and a decreased sense of belonging for women, while no noticeable difference is observed in their male counterparts (Murphy et al., 2007). In terms of awareness, girls were found to be less knowledgeable and less inclined to discover what a career in engineering entailed and what it can offer, with only 27% expressing to have relevant knowledge compared to 47% of boys (EngineeringUK, 2018; Stoet & Geary, 2018). The same study reports that parents and teachers are more inclined to recommend an engineering profession to male than female children. This can be problematic as parents and teachers form key career advisors in younger ages.

The misconception that biological and personality traits prevent females from excelling in STEM disciplines is another stereotype that contributes to the problem. Perceived masculine personality and cognitive traits (***Table 1***) are considered crucial elements for achieving success in male dominated disciplines, such as Engineering (Cejka & Eagly, 1999). However, this survey demonstrated that the likelihood that these traits would be possessed by men

and women does not differ drastically (***Table 1***). Biological differences in aptitude are groundless as girls outperform or are equally capable to boys in STEM subjects (EngineeringUK, 2018; Stoet & Geary, 2018). Additionally, female students in Engineering achieved more 1st or 2:1 degrees exceeding by 5.5% their male counterparts (EngineeringUK, 2020).

Table 1*: Masculine traits - adapted from Cejka & Eagly, (1999).*

Dimension	Masculine Personality	Masculine Cognitive
Traits	Competitive	Analytical
	Daring	Mathematical
	Unexcitable	Good with numbers
	Dominant	Exact
	Adventurous	Good at reasoning
	Stands up under pressure	Good at abstractions
	Aggressive	Good at problem solving
	Courageous	Quantitatively skilled
Likelihood traits to be possessed by men	75%	68.8%
Likelihood traits to be possessed by women	61.2%	65.2%

Significant problems are also apparent with post-university female retention in engineering professions (McWhinnie & Peters, 2017). A “leaky pipeline” is often used metaphorically to describe the progressive loss of female professionals in STEM (Resmini, 2016). Workforce underrepresentation of women creates an un-welcoming environment. This is not necessarily related to sexist attitudes, but the sheer male majority forms a male-oriented working culture, leaving the minority to adapt to fit in. In such environments, the visibility paradox applies, i.e. women tend to be very visible as women, but highly invisible as engineers and unfortunately, women need to demonstrate increased effort and performance compared to their male counterparts to be considered as serious engineers (Faulkner, 2013).

Discrimination is also apparent in pay scales. The Engineering pay gap in the UK is 10.8% whilst female representation in ascending pay quartiles decreases steadily compared to their male colleagues (Royal Academy of Engineering, 2020) (**Figure 5**). This demonstrates a poor career progression for females, with only a handful making it to the top of the professional ladder. Inevitably, the shortage of female senior engineers / managers leads to lack of inspiring female role models. Although both female and male role models can be very effective for recruitment purposes in Higher Education, the lack of female role models forms a barrier for female retention in engineering professions (Drury et al., 2011). The figure of a female role model can be a strong incentive for female professionals experiencing negative attitudes during work, demonstrating that women can succeed in Engineering. All these factors coupled with the greater domestic responsibility, including

childcare, that women are often burdened with, and the lack of flexible opportunities in the engineering industry force women out of engineering professions.

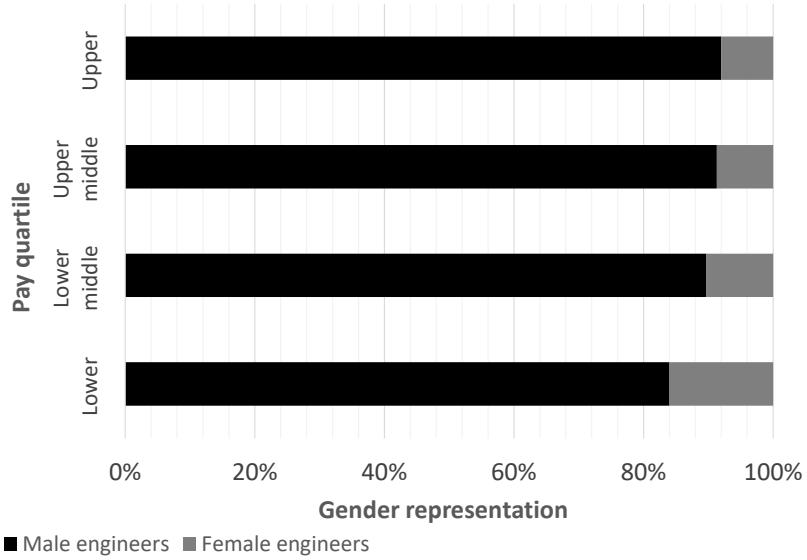

Figure 5*: Gender representation in pay quartiles of Engineering based on Royal Academy of Engineering (2020) data.*

Strategies towards gender parity in Engineering

It is evident that that underrepresentation of women in Engineering is a complex problem begging the question "How can we make Engineering a welcoming place for all genders?". Strategies to alleviate the disparity need to be simultaneously focused at three levels namely, primary, and secondary education, University, and work environment. These strategies, described in detail in the next sections, can be grouped under their overarching aims to raise awareness, battle stereotypes and gender bias and promote an inclusive learning and working environment (***Figure 6***).

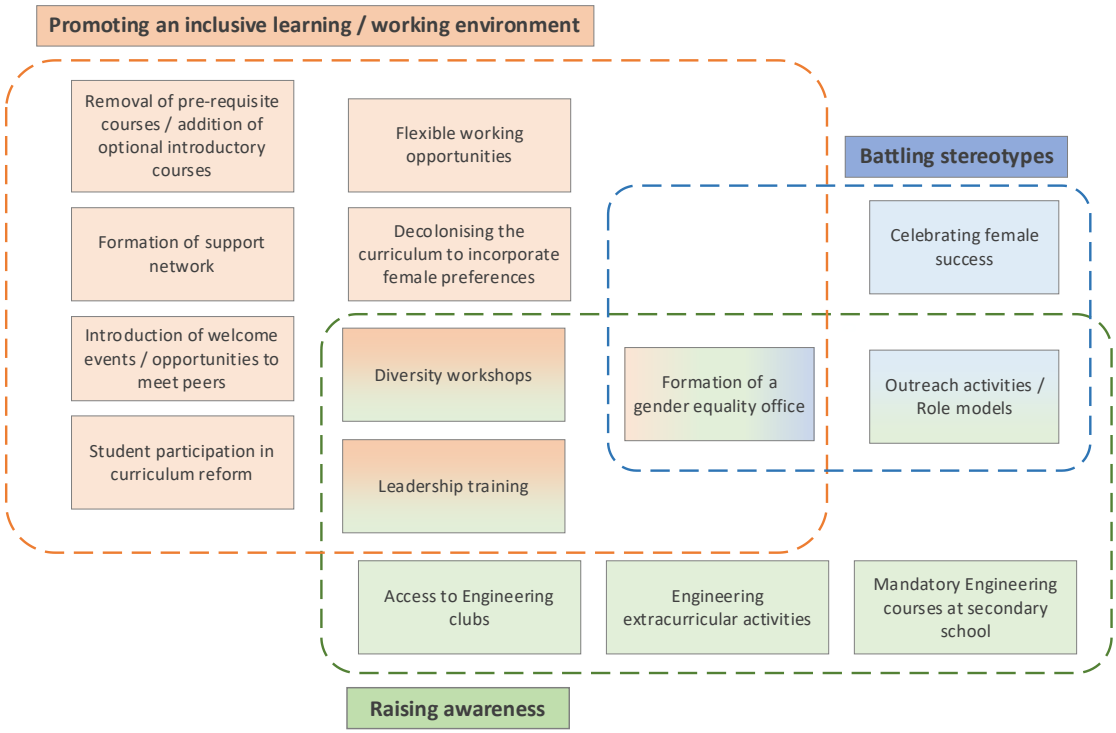

***Figure 6**: Overview of strategies that may be used for addressing gender disparity in Engineering.*

Primary – secondary education strategies

The underlying causes of underrepresentation of women in Engineering, commence well before university and are related to insufficient exposure to Engineering or the masculine culture and stereotypes associated with the field. Primary and secondary education strategies can be implemented to address this and increase female recruitment in Engineering. Compulsory school courses such as maths, chemistry, and biology were found to have a positive impact in female representation at relevant University programmes (Cheryan et al., 2017). However, even when courses in Engineering (including computer science) are available in schools, these are often optional and many students opt out (Cheryan et al., 2017). Introducing a mandatory preliminary Engineering course in secondary education, potentially within a science curriculum could improve understanding and increase exposure to the industry, which will eventually attract more female students to the field. Exposure could be complimented with extracurricular activities with an Engineering focus, e.g., group activities for building a newspaper tower or a matchstick bridge. Moreover, access to female Engineering clubs (e.g., Girls Who Code or Girls in Tech similar to arts, language or literature clubs) could build confidence and a sense of belonging to female students, which can in turn balance gender bias and stereotypes (Barabino et al., 2019).

Family and role models also have a significant part to play in career choices. Turkey currently outperforms the UK and the US in female representation in Engineering. Family and close relatives working in the industry were found to function as role models, having a

significant positive influence in reducing gender bias in the country (Smith & Dengiz, 2010). Although it is not possible for every family to have an engineer, the introduction of outreach activities, aimed at primary and secondary schools during career counselling courses, are crucial (Mohamed, 2014). These could be led by both male and female academic staff, providing Engineering role models for students to relate and look up to, taking inspiration for their future studies.

University strategies

Universities can form the second key player in achieving gender parity in Engineering. This could be achieved through curriculum reform strategies, implemented at department, programme, module and support network levels for creating a welcoming learning environment for all Engineering students, irrespective of their gender.

Departmental strategies

Building an inclusive community and a sense of belonging should commence from the early university days. The introduction of welcome events and activities, where students get the opportunity to meet faculty and peers across the department, can increase the students' sense of belonging. Same gender contacts can be made in such events, that may function as a future support network in case of gender bias or sexist attitudes encountered during their studies (Sagebiel & Dahmen, 2006). The sense of belonging could be even influenced by phenomenally innocent cues in department brochures and logos, which subconsciously convey powerful messages (Mohamed, 2014); these need to be carefully designed with inclusion in mind, using a mixture of female and male students, to oppose stereotypes and make them relatable to all students. All actions at a departmental level, can be supervised by a gender equality office (García-Peñalvo et al., 2019). The introduction of such an office can prove useful for Engineering and other STEM fields that currently lack gender parity, as they can supervise, monitor progress, propose department-wise strategies, and put pressure on senior management to pursue policy changes and curriculum reform.

Programme strategies

Curriculum involves everyone from senior management to academics and students. Engagement with others can help reflective practice and allow co-creation of knowledge to address gender disparity. All partners should therefore contribute to curriculum reform, including students. However, it is important for students to first become familiar with the challenge. This could be achieved through attendance to mandatory diversity workshops during their first year. This will include talks by invited, female and male, guest speakers from academia and industry, describing their experience and challenges to date. The aim of this session is to raise awareness on female underrepresentation, clarify the importance of multi-perspectivity and gender balance in work environment and actively engage students in diversity discussions (Cheryan et al., 2017; Schäfer, 2006). Subsequently, students could be involved and consulted in curriculum development as student representatives attending

programme committees and module approval committees to provide feedback to the academic team and pass feedback back to their cohorts (Keele University, 2021).

Additionally, the removal of pre-requisite modules such as computer science which may prevent students from selecting University programmes, and the addition of introductory modules at university level, to provide the necessary background knowledge for commencing their studies, could attract more female students in Engineering (Cheryan et al., 2017; Mohamed, 2014). Tailoring the programme to female preferences could also be a strong incentive. Previous studies identified the interest of women in interdisciplinary and non-technical modules, such as soft skill or language modules (Sagebiel & Dahmen, 2006). Although faculty may appear sceptical on how these can be introduced in the curriculum without removing essential modules, these could still be offered at an optional basis, providing a personalized education to student needs and preferences.

Module strategies

The student experience largely depends on interest. Interest may therefore be considered as the foundation of learning. It was found that female students feel more connected when their studies are observed from a human, social and environmental perspective (Imasogie et al., 2019; Romkey, 2007). The Engineering curriculum could be therefore diversified by thinking how students of different gender experience the university in their own way, followed by reframing and reconstructing the current curriculum to make it more inclusive (Keele University, 2021). Most Engineering modules are highly objective, technical, and heavy on design processes based on mathematics, science and hard data. Backward design might prove a powerful tool in placing the curriculum in a social, global, and environmental context without limiting the technical content that needs to be covered. This could be achieved in the sequence of identifying the desired outcomes, determining what parameters will constitute acceptable evidence and planning teaching and learning activities accordingly (Wiggins & Mctighe, 1999). Workshops, involving only the relevant academic team, could be organised at module level to work on backward design. These could be supervised by the gender equality office and supported by student consultation once module plans become available. Alternatively, a human, social and environmental dimension could be given to Engineering by linking theory to real world input, using diverse applications and case studies from around the globe to show the multicultural dimension of the field. This could be implemented at all aspects of learning, including presentation slides, lecture notes, activities, and coursework to make the content relevant to all students.

Support network

Forming a support network during academic study is vital for both genders, although it may be even more so for female students, when they are the minority population. Support networks could be based on peers, clubs, or tutors (Cheryan et al., 2017).

Events including welcome, team-building activities or fieldtrips could provide a useful occasion to mix students of different levels and help them establish contacts for building an

informal support network, that can increase their sense of belonging. Formally organised groups, e.g. Women in Engineering, are also helpful in establishing a safety net. In such groups, female students can attend seminars and gender awareness meetings, meet one another, and offer support as required (García-Peñalvo et al., 2019). Attendance to conferences and workshops as well as placements for female students can build the confidence and the soft and practical skills, they will need in their professional careers (Barabino et al., 2019; Imasogie et al., 2019). Female tutor mentoring is also valuable for creating a welcoming environment and a safe space for female students to discuss any problems they face. This is also a good opportunity for students to associate with faculty, while faculty play a double role of mentor and an inspiring role model (Imasogie et al., 2019; Romkey, 2007; Tunji-Olayen et al., 2017).

Work environment strategies

It is important to stress the need for measures to be also taken at the work environment to reduce the "leaky pipeline" phenomenon. Without a significant improvement in the work environment, gender disparity in Engineering can never be resolved. Strategies to promote gender parity could be introduced as government or individual company actions to support women in their roles.

Leadership development programmes, funded by the Government Equalities Office, can be offered to female engineers to support their career progression. Governmental pressure can be put on companies and incentives can be provided for offering part time opportunities. Such opportunities are not frequent in Engineering roles but can attract and be well suited for female engineers with childcare responsibilities. At company level, mentoring programmes should be offered (Barabino et al., 2019; Tunji-Olayen et al., 2017). Female senior engineers could act as mentors for less experienced female engineers, as the former are well familiar with the challenges that the latter may face during their career and provide tailored advice. Finally, celebration and acknowledgement of success of female engineers is equally important as it is a powerful tool for creating role models, battling stereotypes, and convincing that success in the field is indeed feasible by women (Barabino et al., 2019).

Conclusions

This study shed light on the extent and root causes of the gender disparity in Engineering, proposing potential remedial interventions to improve the current landscape. Female students comprise 20% of total Engineering students in the UK with even fewer female engineers (10%) continuing to become professional engineers. Data specific to the University of Hertfordshire (UH) revealed more pessimistic results, with only 11% females in the Engineering student population. The reasons behind the gender disparity are multifaceted and are a mixture of personal preferences, gender discrimination, stereotypes, social influence and expectations, lack of role models and sense of belonging, and unequal or inflexible opportunities.

This study proposed potential interventions that could be implemented at three distinct fronts namely, during primary and secondary education, University, and work environment. Actions included tailoring Engineering studies to female preferences, provision of formal training as necessary (e.g., leadership training or diversity training), promoting the formation of a support network through peer engagement and mentoring schemes, establishing supervisory bodies to ensure policy change, providing role models, and supporting outreach activities and celebration of female success, among others. All these strategies aim at raising awareness of the gender disparity in Engineering, battling stereotypes and gender bias, and promoting an inclusive learning and working environment to encourage women to flourish in the field. However, this is not a quick fix. Further investigation is required to quantify the effectiveness of these strategies by monitoring their influence on the female student- and professional engineer populations. If successful, these strategies could also become the stepping-stone for addressing gender disparity in other STEM disciplines where gender inequalities are also apparent.

References

Barabino, G., Frize, M., Ibrahim, F., Kaldoudi, E., Lhotska, L., Marcu, L., Stoeva, M., Tsapaki, V., & Bezak, E. (2019). Solutions to Gender Balance in STEM Fields Through Support, Training, Education and Mentoring: Report of the International Women in Medical Physics and Biomedical Engineering Task Group. *Science and Engineering Ethics*, *26*(1), 275–292.

Cejka, M. A., & Eagly, A. H. (1999). Gender-stereotypic images of occupations correspond to the sex segregation of employment. *Personality and Social Psychology Bulletin*, *25*(4), 413–423.

Cheryan, S., Ziegler, S. A., Montoya, A. K., & Jiang, L. (2017). Why are some STEM fields more gender balanced than others? *Psychological Bulletin*, *143*(1), 1–35.

Drury, B. J., Siy, J. O., & Cheryan, S. (2011). When do female role models benefit women? The importance of differentiating recruitment from retention in STEM. *Psychological Inquiry*, *22*(4), 265–269.

EngineeringUK. (2018). *EngineeringUK briefing: Gender disparity in engineering*.

EngineeringUK. (2020). *Engineering UK 2020: Educational Pathways into Engineering*.

EngineeringUK. (2022). *Women in Engineering - Trends in women in the engineering workforce between 2010 and 2021 - Extended analysis*.

Eurostat. (2022). *Eurostat Data Browser: Employed HRST by category, sex, age and NACE Rev. 2 activity*.

Faulkner, W. (2013). Doing gender in engineering workplace cultures. II. Gender in/authenticity and the in/visibility paradox. *Engineering Studies*, *1*(3), 169–189.

Gaines, J. (2017). *Women in Male-Dominated Careers*. Cornell HR Review.

García-Peñalvo, F. J., Bello, A., Dominguez, A., & Romero Chacón, R. M. (2019). Gender balance actions, policies and strategies for STEM: Results from a world café conversation. *Education in the Knowledge Society*, *20*, 1–15.

Hunt, V., Prince, S., Dixon-Fyle, S., & Yee, L. (2018). Delivering through Diversity. In *McKinsey & Company*.

Imasogie, B. I., Oyatogun, G. M., & Taiwo, K. A. (2019). Enhancing gender balance in engineering education and practice. *2018 World Engineering Education Forum - Global Engineering Deans Council, WEEF-GEDC 2018*.

Keele University. (2021). *Decolonising the Curriculum: Staff Guide* (Issue February).

McWhinnie, S., & Peters, J. (2017). Diversity in Engineering: Exploring inspirations, aspirations and destinations of potential engineers by gender, ethnicity and socioeconomic background. *Women's Engineering Society (WES)*, 1–8. https://doi.org/10.18356/a42be186-en

Mohamed, A. O. (2014). Initiatives for Attracting and Retaining Female Students in Mechanical Engineering. *Proceedings of the Canadian Engineering Education Association*, 1–4.

Murphy, M. C., Steele, C. M., & Gross, J. J. (2007). Signaling Threat-How Situational Cues Affect Women in Math, Science, and Engineering Settings. *Psychological Science*, *18*(10), 879–885.

Resmini, M. (2016). The "Leaky Pipeline." *Chemistry - A European Journal*, *22*(11), 3533–3534.

Romkey, L. (2007). Attracting and retaining females in engineering programs: Using an STSE approach. *ASEE Annual Conference and Exposition, Conference Proceedings*, 12.295.1-12.295.29.

Royal Academy of Engineering. (2016). *Engineering and economic growth: a global view*.

Royal Academy of Engineering. (2020). *Closing the engineering gender pay gap*.

Sagebiel, F., & Dahmen, J. (2006). Masculinities in organizational cultures in engineering education in Europe: Results of the European Union project WomEng. *European Journal of Engineering Education*, *31*(1), 5–14.

Schäfer, A. I. (2006). A new approach to increasing diversity in engineering at the example of women in engineering. *European Journal of Engineering Education*, *31*(6), 661–671.

Smith, A. E., & Dengiz, B. (2010). Women in engineering in turkey - a large scale quantitative and qualitative examination. *European Journal of Engineering Education*, *35*(1), 45–57.

Stoet, G., & Geary, D. C. (2018). The gender equality paradox in STEM education. *Psychological Science, 29*, 581–593.

Tableau Server. (2022). *University of Hertfordshire - Student Data Dashboards*.

Tunji-Olayen, P. F., Omuh, I. O., Amusan, L. m., Afolabi, A. O., Ojelabi, R. A., & Ogundipe, K. E. (2017). Attracting and Retaining Female Students in Construction Related Programs. *Turkish Online Journal of Educational Technology*, 425–430.

Wiggins, G., & Mctighe, J. (1999). *The Understanding by Design Handbook* (Issue May). ASCD Association for Supervision and Curriculum Development.

World Economic Forum. (2022). *Global Gender Gap Report 2022: Insight Report*.

Enhancing employability of engineering graduates using authentic assessment

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Abstract

Engineering graduates leaving university are expected to have both discipline-specific and non-technical skills. In many countries, professional engineering bodies dictate these skills, with the onus on universities to produce workplace ready graduates. One way of enhancing employability of engineering graduates is to expose them to authentic assessment during their programme of study. Authentic assessments often require students to use and develop their technical and non-technical skills to solve ill-defined problems similar to those they may encounter in industry. This article begins with a literature review that focuses on three key areas: graduate employability, the pedagogic theory of authentic assessment and methods of implementing authentic assessment. Each source reviewed typically addressed only one or two of these three areas. There was no clear linking of pedagogic theory to practice to ensure that engineering students leave university with the skills employers and engineering bodies require. A model based on the principle of backward design is therefore proposed to guide practitioners when designing their own authentic assessments. Finally, a critical reflection on the author's experience of authentic assessment at the University of Hertfordshire is presented.

Introduction

Competition for graduate jobs in the UK is fiercer than ever, with an average of 91 applicants per graduate vacancy according to a survey conducted by the Institute of Student Employers (Gallacher, 2021). Starting a career is the main reason students cite for going to university (Universities UK, 2022), so it is important that a higher education adequately prepares graduates to enter the workplace.

Employability is a term often used when considering employment prospects, but its meaning does not necessarily refer just to the acquisition of a job. Yorke (2006) defines employability as

> "a set of achievements – skills, understandings and personal attributes – that makes graduates more likely to gain employment and be successful in their chosen occupations, which benefits themselves, the workforce, the community and the economy"

These achievements can be developed through appropriate study and assessment at university. Assessment is regarded by Boud (2010) as playing an important role in forming a 'becoming practitioner' – that is, an individual who transitions from being merely a 'student' to someone who contributes to society in a meaningful way.

Authentic assessment is widely regarded in the literature as being a tool, or model, that academics can use to enhance the employability of students (Villaroel *et al*, 2018). An authentic assessment is one which includes a realistic context and/or allows students to solve "real life" problems; it gives students an opportunity to apply their knowledge in similar ways to professionals in the workplace.

This paper attempts to link the pedagogic theory of authentic assessment with practical techniques that academics can use to help develop students who are better equipped with the skills desired by employers and professional engineering bodies. A critical reflection on the author's own experience designing authentic assessments in the University of Hertfordshire's School of Physics, Engineering and Computer Science is also presented.

Methodology

This article presents a literature review of three key topics: graduate employability, the theory of authentic assessment and implementation strategies for such assessments. The literature surveyed has been restricted mostly to the context of engineering. Existing works were searched for using the Herts Online Library, Google, Google Scholar and ResearchGate, and combinations of search terms such as "authentic assessment", "engineering education" and "enhancing employability".

Literature review

Employability of engineering graduates

In their systematic literature review, Sokhanvar *et al* (2021) identified six 'employability skills' that can be enhanced using authentic assessment: communication, collaboration, problem-solving, applying knowledge to practice, self-awareness, and self-confidence. However, of the 26 papers they reviewed, only one was specific to engineering and the majority were in the fields of nursing and education.

McGunagle and Zizka (2020), on the other hand, conducted a survey of employers to determine desirable skills for science, technology, engineering, and mathematics (STEM) graduates. They found that employers most valued proactive team players who are self-motivated, with good verbal communication and problem-solving skills. This suggests that both STEM and non-STEM employers look for similar qualities when recruiting graduates.

The skillsets identified by Sokhanvar *et al* (2021) and McGunagle and Zizka (2020) compare well with those considered by Merrett (2022) for designing assessments for engineering students: teamwork and leadership, communication, and designing solutions for complex problems. This suggests that non-technical – as well as technical – skills are important for graduates, irrespective of discipline. This is in agreement with the work of Gadola and Chindamo (2019), who state that "companies seem to appreciate soft (non-technical) skills in job candidates no less than hard (technical) skills", and Yorke (2006), who claims that 'soft skills' are considered important in graduate recruitment.

One of the limitations of the papers discussed so far is that they do not consider the requirements of professional bodies. Desirable graduate attributes are often mandated by regulatory engineering bodies and differ depending on location (see, for example, Paul *et al*, 2015 and Isaacson, 2016). In the UK, higher education engineering programmes are accredited by organisations such as the Royal Aeronautical Society, the Institution of Mechanical Engineers, and the Institution of Engineering & Technology. The Engineering Council sets the requirements for accreditation and stipulates learning outcomes that must be met; these learning outcomes ensure that students develop the required graduate attributes (Engineering Council, 2020).

Universities must therefore ensure that engineering graduates (a) have the necessary skills required by employers and (b) can demonstrate the attributes mandated by the relevant professional bodies. It should be noted, however, that (a) and (b) are not necessarily distinct; there are similarities between what employers and accrediting bodies desire. Academics can use authentic assessment to develop students' skills and attributes to satisfy both groups (Villaroel *et al.*, 2018).

The pedagogic theory of authentic assessment

An authentic assessment is defined variously in the literature as one that requires students to use knowledge, skills and attitudes in a similar way as would be required in the "real", or "professional", world (Guilkers *et al.*, 2014; Biggs and Tang, 2011). Villarroel *et al* (2018) suggest that for an assessment to be authentic, it must incorporate realism. Realism can be achieved either by framing a problem in a realistic context, or by presenting a task that is similar to what may be encountered in the workplace.

Bloom's revised taxonomy (Anderson *et al*, 2001) is often cited when promoting the benefits of authentic assessment. The taxonomy attempts to categorise the cognitive processes by which learners use knowledge. Figure 1 shows how these categories can be presented pyramidically – much like Mazlow's hierarchy of needs (Mazlow, 1943) – in the ascending order of remember, understand, apply, analyse, evaluate, and create. Villarroel *et al* (2018) argue that an authentic assessment task involves the use of "higher-order cognitive skills" such as those found towards the top of the pyramid. Students are not required to just recall information but must be able to apply their skills to solve unfamiliar problems; unsurprisingly, these abilities are desirable to employers (McGunagle and Zizka, 2020; Pang and Kootsookos, 2021).

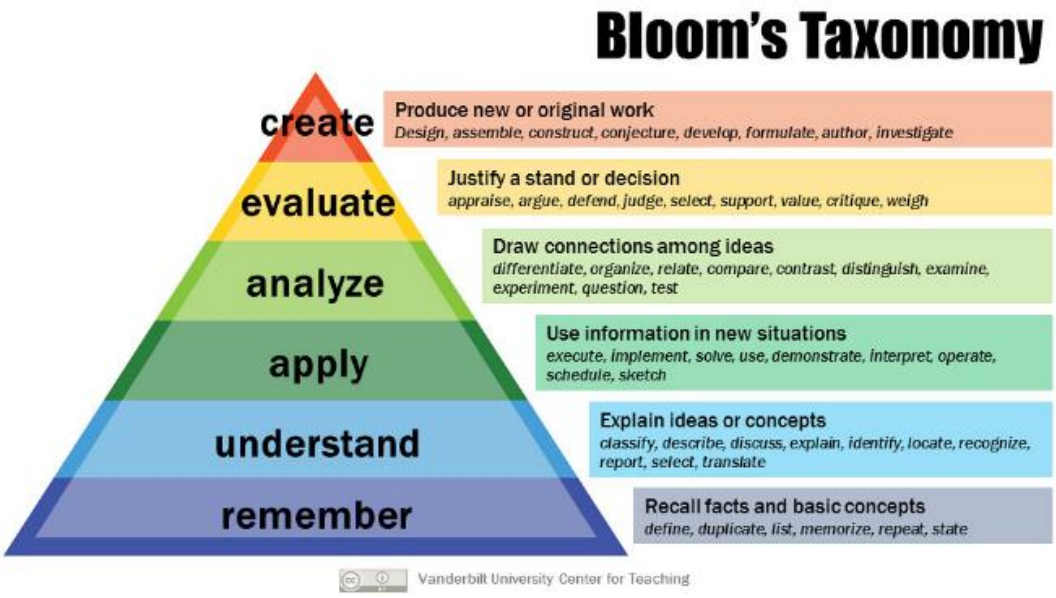

Figure 1: *Bloom's revised taxonomy (Armstrong, 2010).*

Yardley *et al* (2012) and Gadola and Chindamo (2019) suggest that authentic, practice-based learning experiences are beneficial to students. While neither of these works focus specifically on assessment, the authors' appraisals of Kolb's experiential learning cycle are useful, nonetheless. Kolb's experiential learning cycle features four stages: concrete experience, reflective observation, abstract conceptualisation, and active experimentation (Kolb, 1984). Gadola and Chindamo (2019) argue that student engineering competitions, for example Formula SAE, are classic examples of experiential learning; such competitions provide an opportunity for engineering theory to be applied in a realistic "hands on" way. Yardley *et al* (2012) note that Kolb's four-stage cycle has been criticised as being too neat a way of explaining learning. However, the reflective nature of Kolb's work maps well to authentic assessment. Villarroel *et al* (2018) found that 'evaluative judgement' is one of the three dimensions represented in authentic assessment; in other words, students should be able to reflect on their own learning and judge their own performance.

Numerous theoretical models of authentic assessment exist, but similarities between the criteria, or dimensions, of each model are not obvious. Table 1 summarises some of the components of four multidisciplinary authentic assessment models found in the literature.

Table 1: *Components of authentic assessments identified from different theoretical models.*

Rennert-Ariev (2005)	Gulikers et al (2004)	Ashford-Rowe *et al* (2014)	Herrington and Herrington (2006)
Student control over assessment	Assessment tasks	Extent of challenge	Context
Context of student work	Physical context	Assessment outcome	Student factors
Student reflection	Social context	Transfer of learning	Task factors
Interrogation of assessor's practice	Output of assessment	Metacognition	Indicators
Student-assessor relationship	Assessment criteria	Authentic product or performance	
		Fidelity	
		Discussion and feedback	
		Collaboration	

While some of the same components are found across multiple models, for example 'context', 'task' and 'reflection', other similarities are harder to detect. This presents a problem for the practitioner when trying to create an authentic assessment. Which model should they use and why? With academic workload described as "unmanageable" for a majority of staff (UCU, 2022), practitioners may not have time to research multiple models when preparing authentic assessments. What is needed instead is a clear set of guiding principles to follow.

Implementing authentic assessment

Although the pedagogic literature highlights the benefits authentic assessments provide for students, implementing such assessments in an engineering context can be challenging. Pang and Kootsookos (2021) found that the high marking load associated with "real-world

group projects" made it difficult to provide engineering students with detailed feedback. This is supported by Villarroel *et al* (2018) who suggest that academics can be reluctant to modify their existing assessments because of the time, energy and intellectual resources required. Ullah (2020) even argues that efforts must be made to safeguard authentic engineering assessments against contract cheating; however, this is not widely discussed in the literature as being a significant barrier to implementation. These issues suggest that practitioners should be mindful of their own workload and wellbeing when creating authentic assessments.

One method of developing students' ability to transfer skills from education to real-world problems is the use of a CDIO (conceive-design-implement-operate) framework (Chua, 2020). Programmes that adopt a CDIO approach require students to solve problems, often in groups, that are open-ended; that is, where there is no one correct answer. The nature of CDIO is such that students are assessed on their ability to design and build a physical system. The challenges of implementing a CDIO-based curricula are well documented and include the need to restructure or remove entire modules. Also, engineering departments may lack competence in product development and system building (CDIO Initiative, 2022). Merrett (2022) in fact suggests that final year undergraduate group projects should be paper-based design exercises only, since build projects result in increased student workload and scheduling concerns. Academics should therefore carefully consider their (and their colleagues') expertise, in addition to administrative and logistical constraints, when planning authentic assessments.

Merrett (2022) proposes case study-based assessments as an authentic method of testing students' understanding. He found that students performed better during projects and examinations that featured real-world data and context than during more complex build projects. Similarly, Ullah (2020) demonstrates three examples of how examination questions can be written to include authentic elements. These paper-based assessments are arguably more straightforward to administer than many of the multidisciplinary group project examples found in the literature. However, both authors only provide examples of how they have implemented authentic assessments; they do not propose a general structure that other practitioners can follow when creating their own assignments. This issue is further highlighted by Villarroel *et al* (2018) who argue that there is limited literature focusing on practical authentic assessment principles.

A model for creating authentic engineering assessments

The review of the literature highlighted a gap in existing knowledge, in that there is no published conceptual model for creating authentic engineering assessments that enhance employability. A five-step model is therefore presented (Figure 2), which is an adaptation of the backward design model proposed by Wiggins and McTighe (1998). Backward design is the antithesis of traditional curriculum planning; it encourages educators to first consider desired outcomes (or learning goals), then create assessments and finally design learning

activities. The model proposed in this paper applies backward design specifically to the case of authentic engineering assessment.

The model features five boxed tasks, each using an action verb aligned with Bloom's revised taxonomy (Anderson *et al*, 2001) and a series of open-ended scaffolding questions. Practitioners consider each box in order, working from the top to the bottom. The question prompts are designed to break each boxed task into smaller, more manageable parts (West, 2021).

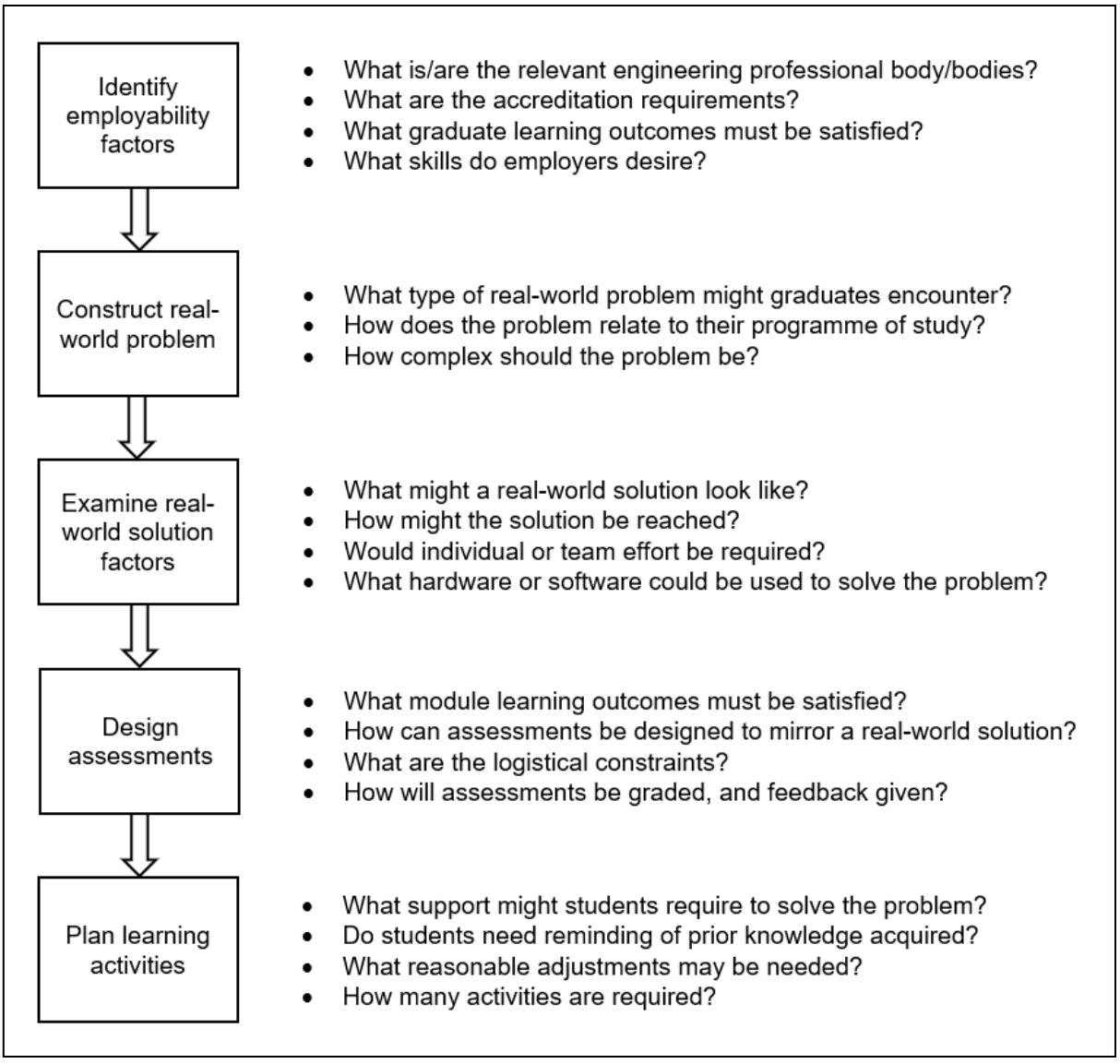

Figure 2: *A five step model for creating authentic engineering assessments.*

The model guides the practitioner to create authentic assessments that enhance graduate employability by first considering the requirements of employers and professional engineering bodies. The second and third boxes prompt the assessment designer to think carefully about authenticity – that is, how best to frame the assessment in a realistic context, or how to provide a realistic problem. Boxes four and five focus attention on

creating specific assessments and learning activities, respectively, taking into account institutional, logistical and module constraints. To illustrate how the model can be used, an example in the context of aerospace engineering is presented in the following paragraphs.

Identifying employability factors

To identify employability factors, the Accreditation of Higher Education Programmes, fourth edition (AHEP4) (Engineering Council, 2020) can be considered. AHEP4 states that Bachelor's level engineering students should be able to "design solutions for complex problems", consider "environmental and commercial matters" and "communicate effectively on complex engineering matters". As found in the literature review, employers value teamworking, problem-solving and communication skills. The requirements of employers and professional bodies in this case are broadly similar.

Constructing real-world problem

It is reasonable to expect that after graduation, 21st century aerospace engineering graduates may be involved in the design or operation of aircraft that do not use traditional fossil fuels. A real-world problem might therefore be the design of an airliner that uses a hydrogen propulsion system; see, for example, Airbus (2022). Clearly this is a complex problem that requires consideration of environmental matters (as specified in AHEP4).

Examining real-world solution factors

A real-world aircraft design programme may require hundreds – if not thousands – of staff, each with a specialist skill set. Computational fluid dynamics, finite element analysis and flight simulation software might be used by aerodynamicists, structural designers, and test pilots, respectively. The entire design process would likely last years, but would include discernible stages such as conceptual design, detailed design, and testing (Raymer, 2018).

Designing assessments

Designing module assessments that reflect this real-world problem requires careful thought. Students could be put into groups with each member assigned a specialist engineering role. Assessments could include an individual discipline-specific written report and a group oral presentation to a technical audience. Such a presentation could take the form of a design review, as would be encountered in industry, where academics ask questions on the proposed design and assess students based on their responses. The use of peer evaluation, where students anonymously grade their teammates' contributions, may also help to increase authenticity (King's College London, 2022). Institutional constraints, for example software licences and flight simulator availability, could however limit the scope of assessments. It is also very unlikely that a higher education institution would have the resources to build a manned aircraft, although this was previously accomplished at Cranfield University (Fielding and Jones, 2000).

Planning learning activities

Finally, solving a (potentially) ill-defined large-scale problem such as the design of an aircraft may require students to assimilate knowledge acquired in previous modules or courses. Planned learning activities might therefore include academic-led refresher tutorials or guest lectures from industry experts, to provide an element of instructional scaffolding (Vygotsky, 1978).

It is hoped that this example has demonstrated how assessments that are rich in context and that present realistic challenging problems can be created specifically to enhance engineering graduate employability. Although the example focused on the aerospace discipline, the generic nature of the model is such that it can be applied to other types of engineering – whether that be a large team project to design a bridge, or an individual piece of coursework to model the dynamics of a car's suspension.

Critical reflection

In order to reflect on my own teaching practice and experience of authentic assessment at the University of Hertfordshire, I have considered the three questions posed by Rolfe et al (2001): What? So what? What now?

What?

My route into academia was somewhat atypical, in that my previous career was industry-based rather than research-focused. When I joined the University of Hertfordshire I had very little teaching experience; this was mostly limited to giving small demonstrations and presentations in schools as a STEM Ambassador. My only experience of assessments was as a student; I had never set, marked or given feedback on coursework or examinations before. I was therefore quite anxious about being asked to write coursework assignments and tests for modules that I had not studied myself.

Most of the guidance I received from colleagues about writing assessments focused on administrative matters. That is, making sure I filled out the correct briefing template, making sure I set up the Canvas page correctly so it would be visible to students and making sure I had the assignment ready for moderation by a certain deadline. The actual content of the assignments was left entirely up to me. While I had access to examples from previous module iterations, I was surprised by the level of freedom I was given. The feeling of imposter syndrome was ever-present. Why should I be trusted to assess students on material that I had developed, but that had not been checked by a more senior academic, and when my teaching practice had never been observed?

So what?

When creating my first assignments I reflected on my own experiences as an undergraduate engineering student. I considered the types of coursework I had enjoyed completing; these inevitably were ones that gave me freedom to select my own topic, or propose my own

solution, often in the context of real-world problems. I also thought about the projects I had worked on in industry and the professional competencies that I had had to demonstrate and tried to frame my assignments in a similar way. In effect, I was creating authentic assessments without realising it. It was not until I started studying for my Postgraduate Certificate in Higher Education (a year after becoming an academic) that I was first introduced to the term 'authentic assessment'.

This was both surprising and reassuring to me. I was grateful for having spent time in industry as I had real-world experience to draw on when creating assignments. I was also pleased that the types of assessment I was developing were recognised in the pedagogic literature. However, I started to think more about how other academics develop assessments. Do they add real-world context? Do they have experience of industry? Is such experience even necessary for creating authentic assessments?

I also began to consider more carefully my students' opinions. Do they enjoy my assignments? Are the assignments perceived as too easy or too difficult? I have found drop-in sessions a useful way of gauging how students are feeling. I often ask open-ended questions such as "how is the assignment going?", both for assignments I set and those set by my colleagues. Unsurprisingly, answers to this type of question vary significantly. Some students enjoy the open-ended nature of authentic assessment, while others complain about the lack of a structure, or template, to follow; in fact, my experiences closely mirror those of Merrett (2022).

Now what?

The questions I have posed throughout this reflection are what motivated me to research authentic assessment in more detail. I plan to continue furthering my knowledge of this aspect of pedagogy because of the possible benefits to both students and staff. The fact that academics are given few practical principles to follow when creating assessments is perhaps cause for concern. While observing others' practice and using previous example assessments are helpful, more defined guidance – especially for junior teaching staff – may help to prevent feelings of imposter syndrome. I plan to share my five-step model for creating authentic assessments with my colleagues, especially those new to teaching.

Finally, it should be noted that the University of Hertfordshire's School of Engineering has adopted a CDIO approach in recent years. While I do not teach on any CDIO modules, I have spoken with colleagues who do and listened to some of their concerns. A number of staff are worried about the workload implications of teaching on these modules, as well as the limited availability of materials and poor student attendance at lengthy scheduled sessions. Their concerns are reflected in the literature I have reviewed as part of this research and warrant more discussion within the department.

Conclusion

This research has explored the pedagogic theories underpinning authentic engineering assessment and highlighted some of the methods educators can use to implement such assessments at undergraduate level.

A review of the literature has shown that, in the context of engineering, there is limited linking of pedagogic theory to practice. It is not clear how authentic assessments should be designed and implemented specifically to enhance employability of engineering graduates. As a result, a five-step model based on the principle of backward design has been proposed. This model helps the practitioner to think about employability factors, real-world problems and solution methods, assessment design, and scaffolding activities.

Implementing authentic assessments can be challenging and future research should focus on quantifying workload implications for teaching staff. Studies involving the use of the model presented in this paper – perhaps to identify its strengths and limitations – could also form the basis of future work.

References

Airbus (2022) *The ZEROe demonstrator has arrived*.

Anderson L. W., Krathwohl D. R. and Bloom B. S. (2001) *A Taxonomy for Learning, Teaching, and Assessing: a Revision of Bloom's Taxonomy of Educational Objectives*. Boston, MA: Allyn & Bacon.

Armstrong, P. (2010) *Bloom's Taxonomy*. Available at:

Ashford-Rowe, K., Herrington, J. and Brown, C. (2014) 'Establishing the critical elements that determine authentic assessment', *Assessment & Evaluation in Higher Education*, 39(2), pp. 205-222.

Biggs, J., and Tang, C. (2011) *Teaching for Quality Learning at University*. Maidenhead, UK: Open University Press.

Boud, D. (2010) 'Assessment for Developing Practice', in Higgs, J., Fish, D. Goulter, I., Loftus, S., Reid, J-A. and Trede, F. (eds.) *Education for Future Practice*. Rotterdam: Sense Publishers, pp. 251-262.

CDIO Initiative (2020) *Challenges to designing and implementing CDIO-based curricula*.

Chua, Y. (2020) ‘THE USE OF AUTHENTIC ASSESSMENT IN CDIO PROJECT’ in *Proceedings of the 16th International CDIO Conference, Gottenberg, Sweden*, 8-10 June, pp. 246-267.

Engineering Council (2020) *The Accreditation of Higher Education Programmes (AHEP), Fourth Edition*.

Fielding, J. P. and Jones, R. I. (2000) ‘Graduate-level design education, based on flight demonstrator projects’, *Aircraft Design*, 3(4), pp. 217-238.

Gadola M, Chindamo D. (2019) ‘Experiential learning in engineering education: The role of student design competitions and a case study’, *International Journal of Mechanical Engineering Education*. 47(1), pp. 3-22.

Gallacher, J. (2021) *Graduate job competition hits record high*.

Gulikers, J., Bastiaens, T. and Kirschner, P. (2004) ‘A fivedimensional framework for authentic assessment’, *Educational Technology Research and Development*, 52(3), pp. 67-85.

Herrington, J. and Herrington, A. (2006) ‘Authentic conditions for authentic assessment: aligning task and assessment’ in *Critical Visions, Proceedings of the 29th HERDSA Annual Conference*, *Western Australia*, 10-12 July, pp. 146-151.

Isaacson, M. (2016) ‘Graduate attributes and accreditation’, *Canadian Civil Engineer*, (Spring), pp. 19-21.

King’s College London (2022) *How can I use peer evaluation?*

Kolb D. A. (1984) *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.

Maslow, A. (1943) ‘A Theory of Human Motivation’, *Psychological Review*, 50(4), pp. 370-396.

McGunagle, D. and Zizka, L. (2020) ‘Employability skills for 21st-century STEM students: the employers' perspective’, *Higher Education, Skills and Work-Based Learning*, 10(3), pp. 591-606.

Merrett C. (2022) ‘Using case studies and build projects as authentic assessments in cornerstone courses’, *International Journal of Mechanical Engineering* Education, 50(1), pp. 20-50.

Pang, T. Y. and Kootsookos, A. (2021) 'Authentic learning activities in engineering design course: What works well to cultivate engineers Australia's professional attributes?', *Practice and Evidence of Scholarship of Teaching and Learning in Higher Education*, 15(1), pp. 53-77.

Paul, R., Hugo, R. and Falls, L. (2015) 'International Expectations of Engineering Graduate Attributes', *11th International CDIO Conference*, 8-11 June, China: Chengdu University of IT.

Raymer (2018) *Aircraft Design: A Conceptual Approach*, 6th edition. Reston, VA: American Institute of Aeronautics and Astronautics.

Rennert-Ariev, P. (2005) 'A theoretical model for the authentic assessment of teaching', *Practical Assessment, Research, and Evaluation*, 10(2).

Rolfe, G., Freshwater, D. and Jasper, M. (2001) *Critical reflection in nursing and the helping professions: a user's guide*. Basingstoke: Palgrave Macmillan.

Sokhanvar, Z., Salehi, K. and Sokhanvar, F. (2021) 'Advantages of authentic assessment for improving the learning experience and employability skills of higher education students: A systematic literature review', *Studies in Educational Evaluation*, 70, 101030.

UCU (2021) *Workload survey 2021*.

Ullah, S. N. (2020) 'Examples of Authentic Assessments in Engineering Education' in *Proceedings of the IEEE Global Engineering Education Conference (EDUCON)*, pp. 894-897.

Universities UK (2022) *Graduate employment: its limits in measuring the value of higher education.*

Villarroel, V., Bloxham, S., Bruna, D., Bruna, C. and Herrera-Seda, C. (2018) 'Authentic assessment: creating a blueprint for course design', *Assessment & Evaluation in Higher Education*, 43(5), pp. 840-854.

Vygotsky, L. S. (1978) *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

West, A. (2021) 'Ch. 11 Scaffolding', in Lombardi, P. (ed.) *Instructional Methods, Strategies and Technologies to Meet the Needs of All Learners.* Granite State College: Pressbooks, pp. 185-201.

Wiggins, G. and McTighe, J. (1998) 'Backward Design', in *Understanding by Design*. Alexandria, VA: Association for Supervision and Curriculum Development, pp. 13-34.

Yardley, S., Teunissen, P. W. and Dornan, T. (2012) 'Experiential learning: AMEE Guide No. 63', *Medical Teacher*, 34(2), pp. 102-115.

Yorke, M. (2006) *Employability in higher education: what it is – what it is not.* York: Higher Education Academy.

Epistemicide – Deconstructing libraries to construct cultural change: A Literature Review.

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Abstract

The decolonisation agenda stimulates many emotions, from those who feel impassioned and enlightened, to those who feel uncomfortable and confused. Much work on 'decolonising the curriculum' has been carried out in universities, by academics, librarians, and students. This article takes a broader look around 'Epistemicide', looking at the destruction of values and knowledge systems.

This article will consist of a literature review around the challenges of implementing a decolonized praxis in terms of the role of libraries. It looks at the literature around epistemicide focussing on how collections are built, acquired, classified, catalogued, and accessed including the role of the 'reading list'. Paulo Freire's work on Critical pedagogy will be woven into the discussion and the practicalities of 'critical librarianship' will be explored.

The literature explores many ongoing projects, acknowledging the decolonisation agenda is being addressed in UK University libraries. However, many epistemic injustices continue to exist. The collections themselves still need a radical cultural shift and librarians need to rethink and change the way they acquire, classify, catalogue, access, and search for literature and resources to surface diverse thinking, a range of knowledge systems and global cultural perspectives.

The roots of Epistemicide

Boaventura de Sousa Santos, a Portuguese sociologist defines epistemicide as "the murder or death of knowledge" (Santos, 2014:20). In the preface of his book Epistemologies of the South he starts by highlighting two key issues. Firstly "the understanding of the world by far exceeds the Western understanding of the world. Second, there is no global social justice without global cognitive justice." (Santos 2014: viii). This article focuses on the systematic destruction of other, rival forms of knowledge in favour of a Eurocentric, Western one, it intends to explore epistemicide in the context of universities and their libraries, examining the equality of knowledge systems in these institutions. It will look at redressing the balance, looking to global wisdom and knowledge systems. The article also aims to explore the theme of global social justice, where every voice is equal, allowing the multitude of knowledge and wisdom which exists around the world to be recognised and respected, each knowledge system sitting side by side.

de Sousa Santos is just one voice in the movement of scholars from the Global South who are challenging the domination of Western knowledge in all its forms. At the heart of

epistemicide is knowledge. The work carried out by Hall and Tandon (2017), focusses on knowledge democracy, and the decolonisation of knowledge. A key message which comes out of their work is that higher education institutions only represent a tiny proportion of the variety, diversity and breadth of knowledge which exists globally. They argue that Universities have a very similar colonial history and are derived from the Western canon and that the history of these institutions has predominantly been created by white male scientists; therefore, they do not include knowledge from all races, genders, or sexualities. The article includes stories, a method often lending itself to other forms of non-Western expression, to demonstrate how cultures and languages are destroyed as well as epistemicide.

Decolonising the University

Some defining moments in recent history include the 2015 ''Rhodes Must Fall'' campaign, the protests involving students from the University of Cape Town which involved the removal of the colonialist statue, which have raised the global awareness of these issues. Other notable campaigns which have student led projects on decolonising and diversifying the curriculum include "Why is my curriculum white? (UCL, 2014), ''Rhodes Must Fall'' at Oxford, Goldsmiths Student Union "Liberate our degrees" agenda and the National Union of Students #LiberateMyDegree (2016) campaign which also highlights the challenge of the BAME attainment gap (UUK, 2019) which exists in many universities.

In setting the scene for decolonising the university curricula, Paraskeva (2016) specifically explores the suppression and elimination of knowledge systems from the curriculum, from different perspectives, including the Middle East, Africa, Southern Europe, and Latin America. This book is an excellent starting point to explore some of these social, cognitive, and epistemological injustices. Tuhiwai Smith (2012:128) talks about in academia "most of the 'traditional' disciplines are grounded in cultural world views which are either antagonistic to other belief systems or have no methodology for dealing with other knowledge systems", therefore excluding a variety of perspectives.

Bhambra (2018) also offers a thorough introduction to the theme and language of decolonising the university in her book and openly starts to discuss Tuck and Yang's (2012:1) article which quotes that decolonisation "is not a metaphor for other things we want to do to improve our societies and schools". The root of decolonisation firmly sits in the repatriation of dispossessed indigenous land; however, the discussion seeks to take a broader view of the term, and maybe 'diversification' should be a more dominant term. Abu Moghi (2021:1) notes the term "decolonisation within academia is becoming an empty term, diluted and depoliticised, allowing for superficial representations that fail to address racial, political and socio-economic intersectionalities". They stress that 'decolonisation' should not be turned into a buzzword or the latest 'trend' to follow.

Gous (2019:3) mentions “culturally relevant pedagogy” but asks the question “how can this be done in responsible and workable ways in which not only valid established wisdom is respected but also novel and local wisdom is embraced?”. Grosfoguel (2013) shares the view that in Westernized universities the knowledge produced from experiences, whether social or historical from the Global South Non-Western are considered inferior. He focusses on gender and how knowledge produced by women is deemed as being inferior, calling out much of the Westernized university as racist and sexist.

Mbembe (2016) writes from a South Africa perspective. He talks about the dominant Eurocentric academic model, and then imagines what the alternative ‘pluriversity’ could look like where knowledge production is responsive to epistemic diversity. Msila (2021:1) focusses on the soul of the South African university “The soul of the university is its fundamental identity which should, it is argued, reflect not only relevance but also cognitive justice, social justice and epistemic liberation.” Epistemicide can look and feel very different across the globe.

As outlined by de Sousa Santos (2015) social justice is key and the social purpose of a university has been challenged in recent history. Universities are dominated by capitalism, colonialism, and patriarchy (Santos, 2021:219) and forget about the humanizing role (Msila, 2021:4). Inequalities in knowledge systems go against the ethos of what is perceived to be an educational environment. Clarke (2021:152) suggests that “the academic library exists within the environment of the university structure and is therefore by default systematically racist “. Information and knowledge empower people and therefore, academics or information and library professionals have a moral duty to provide knowledge around all systems, peoples, cultures, and values.

Curriculum and pedagogy

Curriculum and pedagogy play a vital role when thinking of diversification, and these areas need to be closely re-examined with a different lens if things are to change. The historical origins of university education are flawed in many areas (Santos 2021:220) due to the inherent superiority of the culture of these institutions. Laing (2021:6) says that although there is much emphasis on diversifying the curriculum, it is not only “what we teach that matters, but how”.

Centred around this discussion is a key theme of ‘critical pedagogy’. Paulo Freire (1921–1997) was a leading advocate, his book entitled “Pedagogy of the Oppressed” is influential in the movement. Freire (1972:43) talks about traditional delivery methods in education which he terms ‘banking’ concept, which turns passive students into “containers”, into “receptacles” to be filled by the teacher. The teacher is the one who deposits the education. He continues

"Instead of communicating, the teacher issues communiques and 'makes deposits' which the students patiently receive, memorize and repeat." (Freire, 1972:45-46)

He aimed to challenge this, his approach involves critical thinking and pedagogy which encourages participation. Freire suggests that learners must develop a critical consciousness and discussion is key between the learner and teacher for education to be liberated. He also talks about 'conscientization' in his work, the ways in which individuals and communities develop a critical understanding of their lives through changing social, political and economic consciousness. Zemblylas (2019) critiques Freire's pedagogy and talks about reinventing critical pedagogy as decolonizing pedagogy bringing 'empathy' into the discussion and continues the debate.

Pagowsky and McElroy (2016: xvii) go on to define critical pedagogy as "as engaging in the theory and practice (or praxis) of inclusive and reflective teaching in order to broaden students' understanding of power structures within the education system and in society." Freire's work has been instrumental in the rise of the 'critical librarianship' movement, which involves critiquing library structures the ideologies that support them, and we will reflect in this throughout the article.

Literature review and themes

This article is based on secondary research and will look at literature around epistemicide and the wider challenge of implementing a decolonized praxis in libraries. This includes how information and knowledge is acquired, catalogued, classified, discovered, and presented including the role of 'reading lists' as a tool to change thinking and knowledge. Several bibliographic databases will be searched and there will be a focus to capture diverse articles from a variety of countries and authors. Due to the bias of Western literature, which will be discussed later, the review aims to reach further through discovery of sources through citation searching by including relevant citations and references from the articles found. See Table 1 for the search strategy adopted.

Table 1: *Search Strategy explained*

Databases searched – 22/12/22 (with brief explanation)	Search terms used	Number of references found
Scopus A broad database covering many subject areas, good coverage from articles in many languages/covering many geographic regions, dominant	Epistemicid* AND univ* Epistemicid* AND libr*	36 1

from Western Europe, North American, Asia Pacific, East European (including Russia)	"reading list" AND decolon*	16
Education Research Complete A database covering education subject areas, coverage mostly from Europe and USA/Canada and Australia.	Epistemicid* AND univ* Epistemicid* AND libr* "reading list" AND decolon*	26 0 4
Library Search UH library catalogue. This includes all UH owned subscriptions. The search was also set to “Add results beyond your library's collection” which picks up Open Access material as well to give as wide coverage as possible. Results are displayed in relevance order.	Epistemicide AND univ* Epistemicid* AND libr* "reading list" AND decolon*	288 65 121
Google Scholar There is not a published list of journals indexed/crawled or publishers’ material in Google so it is difficult to ascertain coverage. Due to the nature of the database and search functionality many more references were found, so a filter was added afterwards.	Epistemicide AND university Epistemicide AND library	About 8,850 Filter since 2021 About 3,460 results About 3,460 Filter since 2021 About 1,430 results

Many articles not relevant once titles/abstracts screened. However, it was decided that the search was useful to find alternative material not picked up elsewhere. Not all pages were scanned though as too many results. Google displays results in relevance order.	"reading list" AND decolonisation	About 1,440 Filter since 2021 About 493

Epistemicide and decolonising/diversifying the library

Epistemicide related to libraries has not featured a great deal in the literature to date, although the topic is starting to be explored by some scholars. Patin et al (2020:1) writes from a library perspective and defines epistemicide as “the killing, silencing, annihilation, or devaluing of a knowledge system” and they talk of the “glaring hole in Library and information science literature”. They discuss the subject of epistemic injustice and the harm that is being done in terms of ‘not knowing’, which is prevalent when only a select amount of information and knowledge is available or made available. They look at starting to correct the injustices that currently exist in this key paper.

Firstly, the systems in libraries do not represent diversity. Littletree, S. and Metoyer (2015) highlights a project called the ‘Mashantucket Pequot Thesaurus of American Indian Terminology’ which was designed to include an Indigenous perspective into cataloguing and classification systems. This presents a wider issue of increasing the awareness of the injustice that exist, the ‘silencing’ of other knowledge available. One of the goals of the project was to inform the Library of Congress Subject headings, an internationally known system which is used to classify material in libraries. These headings themselves have been target of criticism because of the way they were established, centred on white male authority. A similar project was carried out by Masterson et al (2019) where a project was conducted at Galiwin’ku Community Library, East Arnhem Land in the Northern Territory, Australia, looking at a new culturally relevant classification scheme for the collection, to replace the existing ‘Western’ approach. Not only cataloguing but also classification systems are highlighted by Patin et al (2020:9) as reproducing epistemic injustice, “libraries using these classification systems provide a space for epistemicide, which strengthen the distribution of the dominant knowledge system.” For such fundamental systems to be flawed will potentially result in much upheaval in the profession.

Cambridge University decolonising through critical librarianship group (2021:208) have also carried out similar work on changing classification schemes and bibliographic records to be more inclusive and accessible. In their project around reclassifying the Polar Library they

worked with students as co-investigators, in workshops, using Freire methodology so the "students could bring their lived experiences to critique the classification scheme". This approach highlighted the flawed information systems that are being worked with and again, called for a change in re-cataloguing practices.

Another area which Patin et al (2020) highlights is the issues around Western bias in terms of publications, and the ease to which a library user can access a range of sources. This is also highlighted by Masaka (2017), Okech (2020) and Zhao (2020). Berger (2021:383) picks up on this area in terms of Open Access publishing, being dominated by Northern publishers, disadvantaging those in the Global South. Berger uses the term 'bibliodiversity', which she describes as being a "sustainable, anticolonial ethos and practice developed in Latin America — the South can reclaim and decolonize open access and nurture scholarly communities." The article finishes with some examples of open access initiatives from the South, including library-based publishing in Africa, which aims to refocus the term open access and provide knowledge to all. This sort of initiative should be shared to increase its global outreach.

Tuhiwai Smith (2012) looks at challenge of finding suitable journals that publish traditional knowledge. The academic environment itself validates certain kinds of knowledge more than others. Some forums have been created to share indigenous scholarship, but these are still in the minority. She also covers the challenges of research methods, values, and practices, citing that it is the way research is thought about and designed which is flawed, especially regarding indigenous peoples. Crilly (2019) talks about the struggle with challenging acquisition processes as a barrier to the 'pluriversity' model and there should not be a reliance on dominant published sources.

Some articles found in the searches are written in a story or narrative approach to get their message over, deliberately trying to break away from the traditional format of the articles which is dominant in Western academic literature. Bennett (2007:152) weaves a fairy tale with a narrative in her article, highlighting that this is "considered a perfectly valid way of transmitting the collective wisdom of a community". The removal of a traditional storytelling language was also noted by wa Thiong'o (1992). Both can be deemed as a form of epistemicide, as when these other voices are ignored by the literature and publishers as they are unrecognisable from the normal formats, therefore their stories do not get heard.

Taking a closer look at how knowledge is discovered is a key area where more work needs to be done in libraries as many are still very much Eurocentric and Westernised. Chambers et al (2018:181) talk about the methodologies used by a diverse team of researchers, predominantly Indigenous (Aboriginal) and African descendant scholars working with allied (White settler) researchers. They were carrying out a scoping review and noted how this methodology was steeped in Western, Eurocentric attributes, tapping into existing literature sources and types of evidence available in the Western world. The paper continues to reflect on the process which in itself "homogenizing the literature and possibly erasing

important nuances and outliers through the process". They talk about tensions they encountered including the language used and how they chose the inclusion/exclusion criteria as by doing this they were eliminating different viewpoints. They evolved their methods to include dialogues with the diverse research team and a more reflective stance, this included a 'sharing circle' format. Freire also encouraged work in small groups which embrace the written word, but also music and other forms of expression.

Thambinathan and Kinsella (2021) also suggest research practices to take forward include decolonial learning and critical reflexiveness and embracing other(ed) ways of knowing. This conclusion sits alongside the work of Paulo Freire as he was a keen advocate of the need for critically reflexive practice in education. He suggests that critical pedagogies need to overturn traditional pedagogies, the impact of the actions should be at the heart of learning. Critical librarianship as a pedagogy is vital as Librarians often teach information literacy skills including research methods. Brookbank and Haigh (2021) showcase many examples of critical library pedagogy. These include examining the concepts of 'information privilege' where social structures which influence the accessibility of material are discussed with students, examining the dominant languages in librarian teaching, and exploring systemic bias of search algorithms and sources and how to teach students to be aware of the issues, often in a one-shot session.

Decolonising the curriculum through reading lists

The activity of reviewing reading list content, looking at the diversity of authors has frequently been documented in the literature. This work is being carried out by academics, library staff and students alike in a variety of global settings. Appendix 1 shows a summary of the papers read.

Laing (2021) talks about decolonising a geography curriculum and looks at students as co-creators in that space and encourages a critical pedagogy and enables students to be active and bring their own perspectives and encourage excitement into the classroom. In those conversations students are individuals and the 'capacity to generate excitement is deeply affected by our interest in one another, in hearing one another's voices, in recognizing one another's presence" (hooks 1994:8). Decolonizing assessment is an interesting area to be explored. This is not specifically something that I can explore in my own role, as like many other academic librarians, my teaching practice often involves one shot-sessions and assessment for this activity rarely takes place. I see my role as enriching the students' learning through critical discussion, using reflection, and examining current practices to challenge the prevailing hierarchies in education.

Schucan Bird and Pitman (2020) and Arshad (2021) investigate the methodology of reviewing the authors on reading lists. They examined them by gender, ethnicity, and geography, finding that the lists were more likely to represent the profile of the academics rather than the students. Reflecting on the work in this area, the challenges are complex

thinking about the categories of diversity, race and gender chosen and the difficulty in assigning the data for those authors due to limited information or multiple authors alongside the ethical issues in carrying out this analysis.

For there to be a critical pedagogic approach akin with Freire the students need to critique the lists for themselves and ask questions to challenge the list producer and link knowledge to action. The role of the student is crucial to bring change.

Reflecting on the literature, the process of analysing reading lists is documented in many papers highlighting that the decolonisation agenda in terms of the variety of sources made available. This is only the first step of the challenge though.

Revisiting stock selection in terms of the authors chosen, the viewpoints and voices demonstrated, within reading lists will play a major part. If reading lists are re-examined through difference lens, the readings on lists may change then this will filter through, new voices and material can be made available alongside existing ones. McCartney and Wilkinson (2021:307) relate to Freire's pedagogy "Transitioning to a collection management model that expands on reading lists to incorporate less dominant, but valid and varied voices, ensures that we are not 'banking' books but 'being with' global knowledge".

Academics may feel uncomfortable and challenged. Library staff can help to introduce new sources, helping to reduce the issues of academics 'not knowing'.

> "Librarians can therefore be instrumental in creating change in the classroom, and potentially even in the institution itself. Librarians offer an invaluable service to academics by providing what they don't yet know that they are missing. It is a service for which there is a great, unrecognized, need and through which the librarian may demonstrate their status as an academic equal. " (Brookbank & Haigh, 2021:308)

There is a vital role to play for librarians to be change agents. Other sources need to be explored which go beyond traditional books and journals, stories, videos, podcasts, and poetry for example. The challenge of acquiring different sources and material can be complicated. Open Access resources should be explored to go beyond the realms of university catalogues. This aligns with Freire, who also embraced the written word, but also advocated music and other forms of expression, these two points sit side by side.

When this work involves students, the results are much richer, ideas are challenged, discussed, and critiqued, power is shared, and ideas liberated. Freire encouraged education where people bring their own knowledge and experience into the process. This sort of activity can be weaved into information literacy sessions to encourage students to embrace a wider selection of material, for example Haigh (2021) explore the idea of a culturally sustaining pedagogy, which supports cultural pluralism and cultural equality, using examples and experiences from the students themselves.

Clarke (2021) talks about building a movement where people need to do the work first, as without them no change will occur. She talks about Librarians as activists and how change rarely come from those in power, but from grassroots initiatives and this appears to be the case in many examples drawn out in the literature.

Concluding remarks

More needs to be done to redress the balance of knowledge in university libraries which goes beyond individual libraries. Collaboration is key to effect structural and institutional change which goes across the sector. The longer-term impact of diversifying reading lists to is unknown though at this stage and more work is to be done. Reflecting on the literature around critical librarianship and pedagogy, the librarian, as gatekeeper to the knowledge can play a huge role in decolonising and constructing cultural change.

Taking a critical information literacy approach around library instruction we also need to look at institutions "and question the dominant voices that operate within them, encouraging our students to do the same" (McCartney and Wilkinson 2021:324) and increase awareness of the biases that exist, by allowing students and staff to be critical in their choice of literature and resources they use and learn from others. Acknowledging critical pedagogy, the librarian/teacher can work with students, with mutual respect, making sure everyone feels safe and everyone's input and experiences are heard and acknowledged. Whilst supporting students we can advise on alternatives, encourage critical thinking skills at every stage of the literature searching process. This will include reviewing the reading lists, databases and resources chosen, what languages searched and publications they use. This can be a challenge when often information literacy teaching relies on the 'banking' set of instructions and we ourselves find that we need to eliminate our own biases. These skills will take time to develop and by introducing a critical pedagogy into information literacy teaching the "focus on empowering the student by providing them with the skills they need to empower themselves" (McCartney and Wilkinson 2021:322).

To abolish epistemicide, there needs to be an increased awareness of other knowledge systems and how to make them accessible. Chamsaz (2021) details staff led initiatives at the British Library which really starts to ask difficult questions of itself to address many injustices in collection management practices and aims to lead on transformation in the sector. Librarians must act together, rethink the systems we use including how material is procured, catalogued, classified and how it is made discoverable. The established systems need a radical overhaul, including the academic publishing streams. This includes increasing the awareness of indigenous knowledge (Edwards, 2019) and a need to be aware of epistemic supremacy by taking a 'transformative librarianship' approach (Morales & Williams, 2021). Librarians need to be active, challenge themselves, present alternate views and encourage activism. The lack of diversity that exists within the library profession also needs to be addressed. Only by deconstructing libraries we can then start to construct cultural change and start to redress the balance of knowledge available to all.

Appendix 1

Decolonising the curriculum – summary of key readings

Author(s)	**Focus (Discipline and main themes) and *Pedagogy explored.***	**Implications for practice**
Adewumi et al (2020)	Social sciences/humanities. Student/staff collaboration. Looking at the barriers to diversification and decolonisation. UK focus. *Critical race theory*.	Voices of marginalised people must be included in the curriculum. "Diversity Mark" process and "Diversity Mark toolkit"
Adewumi and Mitton (2022)	Social policy area. Practical methodology used. Student/staff collaboration. UK focus. *Critical race theory, critical pedagogy.*	"Diversity Mark" process and "Diversity Mark toolkit". Academics should listen to their (BAME) students' perspectives. Shift in the curriculum to critical thinking, students help to appraise resources. Noted the lack of knowledge of academics in terms of other readings/resources.
Akoleowo, (2021)	The role of South African Scholars in epistemic decolonisation, *Critical pedagogy.*	Role of education around changing society for the good. Role of the teacher to enable students to be critically conscious and as conduits for progressive social movements.
Arshad et al (2021)	Political science. Diversity and decolonization. Review reading lists to assess the range of authors, topics and ideas. UK focus. *Critical pedagogy.*	Review prompted looking at the silences and gaps in reading lists. There was an absence in diversity in theories. The coverage of feminist, critical race or queer theoretical approaches was minimal. Coding method used. Student/staff collaboration.
Clarke (2020)	Diversify and decolonise collections. 'Decolonising the mind' UK focus.	"Liberate our Library" initiative. Empower people with critical thinking and study skills. Noted research uses hierarchical systems and resources which need to be decolonised.

	Critical librarianship, critical race theory.	
Crilly, Panesar and Suka Bill (2020)	Arts subjects. Student/staff collaboration. UK focus. *Critical race theory.*	Highlighted the challenges of auditing lists and identifying more diverse resources, looking a variety of sources. "Liberate the curriculum".
Dreyer (2017)	Theology. Reflection of decolonising the discipline of practical theology. South Africa focus. *Decolonial theory.*	Steps needed to decolonise research practice/ecosystem. Fully embrace humanity. All cultures and practices. Importance of different voices/language. Acknowledge the practical knowledge of practitioners.
Jivraj (2020)	Law. Student led decolonisation project Tensions around institutionalized racism and marginalized academics having to do "diversity work". UK focus. *Critical race theory. Decolonisation theory.*	Crucial to work with students to create a sense of belonging and community. Work on decolonizing the curriculum feeding into assessment and shareable content beyond the classroom.
Laing (2021)	Geography. Decolonizing a module, debate with staff and students. UK focus. *Critical pedagogy.*	It's not what is taught, but how it is taught. Need to look at the diversity of teaching staff as well as material on lists. Student as the educator and bring their own perspectives to the classroom. Students need to engage in a wider variety of learning materials and different forms of knowledge e.g., art, song, and visual performance. Decolonised assessment, using a variety of resources encouraged.

Marsh (2022)	Geography and Law. Decolonising the university. Interviews with five academic researchers. *Critical Information Literacy. Critical Librarianship.* *Decolonial pedagogy.*	Recommendations around how Information Literacy can be viewed to support decolonisation and unsettle the current norms to provoke discussions. This includes non-academic and traditional/textual forms of information, going beyond the Anglo-American publishing models, valuing non-English information as well as realising the non-neutrality of libraries in their organisation and collection policies.
Masaka (2017)	Philosophy. Subject taught excludes the philosophy of the indigenous people of Africa. The call for the Africanisation of the curriculum is not enough and needs clear policies to put into practice. South Africa focus. *Critical pedagogy.*	Epistemicide should be acknowledged and confronted by the institutions and those involved. A change of mind set is needed, more than "shift". Liberate the education sector, more than one knowledge system. More needs to be done to increase literature written by indigenous people of Africa, there needs to be some financial empowerment to allow change to occur.
Okech (2020)	Decolonisation projects with a focus on gender. South Africa and UK. *Critical pedagogy.*	Lack of critical practice. Academic publishing bias, diverse writers not represented. Variety of knowledge should be made available, in different formats. Dominance of English language material. Co-creation of reading lists important. The creation of 'reading circles' to build communities.
Rigney (2020)	Law. Critical of failings in including indigenous scholarship in reading lists. UK focus. *Reflective practice.*	Creating a dialogue between a diverse range of authors, via the site of the reading list and then via the classroom. Allowing students an opportunity to explore different viewpoints, enabling a discussion and conversation, a method used in indigenous life. Expect the process to be discomforting.

Schuan Bird and Pitman (2020)	Social sciences and science. Looked at the methodology of analysing lists including the challenges of deciding on which categories to use, how the data was collected and analysed. UK focus. *Critical Librarianship.*	Lists play a role in decolonising the university, raising opportunities to analyse and revaluate disciplines. Lack of research looking at student view of lists as well as the academic view of lists. More work needed on how to unpack methodologies of this work. Universities need to engage in more discussions about what a reading lists could look like. More diverse programmes of study needed. Structural challenges still exist such as academic publishing.
Shahjahan et al (2022)	Overview of work on decolonising curriculum and pedagogy. Critical analysis of articles and book chapters. Disciplines and universities around the world. *Decolonial theory.*	Discusses terminology used. Continual role of European imperial legacy in higher education. Absence in research in some geographical areas. Other forms of 'empire' to note. Transnational discussions needed in the future. Future research in 'digital spaces' the role of digital technologies. Lack of research in decolonising 'science' subjects.
Sundaresan (2019)	Urban planning in India. Indian authors underrepresented in the geography curriculum. Lack of Indian related material. Silence about this 'dominant epistemic infrastructure'. System does not consider academics or students as proficient in producing high quality, original ideas. Elite structures. India focus. *Decolonial theory.*	Looking at diversity, democracy, critical and imaginative learning community by re-evaluating the education system. Social movement. Interdisciplinarity approach to examine other people's language, terminology and ideas. Looking at a variety of formats in teaching including longer term field visits, practical's, public lectures, and events, to maximise learning. References collected on a weekly basis instead of being created before the teaching, coming from questions raised in discussions with the students.
Taylor et al (2021)	Life sciences. Focus on decolonising to reduce the awarding gap in BAME students. Detailed analysis of	Awareness of diversity in lists should be down to module leaders. Educate staff and students on the roles of racism and colonisation in science. Acknowledge diversity in the curriculum. Issues around academic

	reading list methodology. UK focus. *Critical Librarianship.*	publishing not diverse in authorship. Worldwide look at issues highlighted.
Wilson (2021)	Collection development, Social Sciences. Role of collection development policies and biases. Evaluating collections. Globalisation of Higher education. UK focus. *Critical Librarianship*.	Need to be more assertive in addressing inequalities in collections. Collection development policy that is fit for purpose and able to adapt, review and assess collections. Seek out new publishers and suppliers. Improve discoverability of sources and redress the classification bias. Collaborate with other libraries.
Woloshyn (2019)	Decolonising music, contemporary Indigenous musicians. 'Mixed form article'. Author reflection and excepts from student interviews. Musical works as core texts – refers to different musical types and reflects on musicians in different contexts. Films, music and graphic novels used for each theme. US focus. *Decolonial theory. Critical theory.*	Author struggled to access knowledge as not originated from that community. Turned to local Indigenous organizations and individuals as very little in academic community. Included Indigenous voices in the classroom by using online and visiting lecturers. Assessment involves students' capability in choosing Indigenous-centred sources.
Zhao (2020)	China's suyang curriculum development. Dissects epistemicide in China's curriculum knowledge production. China focus. *Paraskeva's Itinerary Curriculum Theory.*	China's knowledge (re)production -linguistic and language epistemicide. Modern Chinese language is more Westernized, traditional Chinese language traditions are being forgotten and should be the first step to decolonise this.

References

Abu Moghli, M. & Kadiwal, L. (2021) 'Decolonising the curriculum beyond the surge: Conceptualisation, positionality and conduct', *London Review of Education*, 19 (1), pp. 1–16.

Adewumi, B., Bailey, L.R., Mires-Richards, E., Quinlan, K.M., Agyeman, E., Alabi, A.,…Shortridge, T. (2022) 'Cross-disciplinary, collaborative and student-led: developing a change process for diversifying reading lists'. *London Review of Education*. 20 (1) pp. 1-17.

Adewumi, B. & Mitton, L. (2022) 'Diversifying the Social Policy Curriculum: A Collaborative Approach'. *Social Policy and Society: a journal of the Social Policy Association*. 21 (1) pp. 54-67.

Akoleowo, V.O. (2021) 'Critical pedagogy, scholar activism and epistemic decolonisation'. *South African Journal of Philosophy*. 40 (4) pp. 436-451.

Arshad, M., Dada, R., Elliott, C., Kalinowska, I., Khan, M., Lipiński, R. … Shilston, F. (2021) Diversity or decolonization? Searching for the tools to dismantle the 'master's house'. *London Review of Education*. 19 (1).

Bennett, K. (2007) 'Epistemicide: The Tale of a Predatory Discourse'. *Translator (Manchester, England)* 13 (2). pp. 151-169.

Berger, M. (2021). 'Bibliodiversity at the centre: Decolonizing open access'. *Development and Change*. 52 (2) pp.383-404.

Bhambra, G.K., Gebrial, D. & Nişancıolu, K. (2018) *Decolonising the University*. London: Pluto Press.

Brookbank, E. and Haigh, J. (2021) *Critical Library Pedagogy in Practice*. Huddersfield: Innovative Libraries Press.

Cambridge University Decolonising Through Critical Librarianship Group. (2021) 'Cataloguing, classification and critical librarianship at Cambridge University'. In Crilly, J. & Everitt, R. (eds) *Narrative Expansions: Interpreting Decolonisation in Academic Libraries*. London: Facet Publishing.

Chambers, L. A. et al. (2018) Decolonizing Scoping Review Methodologies for Literature With, for, and by Indigenous Peoples and the African Diaspora: Dialoguing With the Tensions. *Qualitative Health Research,* 28(2), pp. 175–188.

Chamsaz, P. (2021) 'Towards decolonising the British Library: A staff-led perspective'. In Crilly, J. & Everitt, R. (eds) *Narrative Expansions: Interpreting Decolonisation in Academic Libraries*. London: Facet Publishing.

Clarke, M. (2020) 'Liberate our Library: doing decolonisation work at Goldsmiths Library. *Art Libraries Journal*. 45 (4) pp. 148-154.

Clarke, M. (2021) 'Liberating the Library: What it means to decolonise and why it is necessary'. In Crilly, J. & Everitt, R. (eds) *Narrative Expansions: Interpreting Decolonisation in Academic Libraries*. London: Facet Publishing.

Crilly, J. (2019). Decolonising the library: a theoretical exploration. *Spark: UAL Creative Teaching and Learning Journal* 4(1), pp.6-15.

Crilly, J., Panesar, L. & Suka-Bill, Z. (2020) 'Co-constructing a liberated/decolonised arts curriculum'. *Journal of University Teaching & Learning Practice*. 17 (2). pp. 120-135.

Dreyer, J.S. (2017) 'Practical theology and the call for the decolonisation of higher education in South Africa: Reflections and proposals'. *HTS Teologiese Studies/Theological Studies.* 73 (4) pp. 1-7.

Edwards, A. (2019) Unsettling the Future by Uncovering the Past: Decolonizing Academic Libraries and Librarianship*. Partnership* 14 (1).

Freire, P. (1972). *Pedagogy of the oppressed.* London: Penguin Books.

Gous, I.G.P. (2019) 'The quest for context-relevant online education'. *HTS Teologiese Studies/Theological Studies*. 75 (1) pp. 1-10.

Grosfoguel, R. (2013) ‘The Structure of Knowledge in Westernized Universities: epistemic racism/sexism and the four genocides/epistemicides of the long 16th century’. *Human Architecture Journal of the Sociology of Self-Knowledge.* 11 (1) pp. 73-90.

Haigh, J. (2021) ‘Developing a Culturally Sustaining Pedagogy: Some Critical Incidents’. In Brookbank, E. & Haigh, J. *Critical Library Pedagogy in Practice*. Huddersfield: Innovative Libraries Press.

Hall, B.L. & Tandon, R. (2017) Decolonization of knowledge, epistemicide, participatory research and higher education. *Research for All*. 1 (1) pp. 6-19.

hooks, B. (1994) *Teaching to Transgress*. Oxford: Taylor & Francis Group.

Jivraj, S. (2020) "Decolonizing the Academy - Between a Rock and a Hard Place". *Interventions (London, England).* 22(4) pp. 552-573.

Laing, A.F. 2021, ‘Decolonising pedagogies in undergraduate geography: student perspectives on a Decolonial Movements module’. *Journal of Geography in Higher Education*. 45 (1) pp. 1-19.

Littletree, S. & Metoyer, C.A. (2015) Knowledge organization from an indigenous perspective: The Mashantucket Pequot thesaurus of American Indian terminology project. *Cataloging & Classification Quarterly*. *53* (5-6) pp.640-657.

Marsh, F. (2022) ‘Unsettling information literacy: Exploring critical approaches with academic researchers for decolonising the university’, Journal of Information Literacy, 16 (1), pp. 4-29.

Masaka, D. (2017) Challenging epistemicide through transformation and Africanisation of the philosophy curriculum in Africa. *South African Journal of Philosophy* 36 (4) pp. 441-455.

Masterson, M., Stableford, C. & Tait, A. (2019) Re-imagining classification systems in remote libraries. *Journal of the Australian Library and Information Association*, *68* (3) pp.278-289.

Mbembe, A. (2016) Decolonizing the university: New directions. *Arts and Humanities in Higher Education*. 15(1) pp. 29-45.

McCartney, C. & Wilkinson, E. (2021) 'Towards a critical curriculum'. In Brookbank, E. & Haigh, J. *Critical Library Pedagogy in Practice*. Huddersfield: Innovative Libraries Press.

Morales, M.E. & Williams, S. (2021) 'Moving toward transformative librarianship: Naming and identifying epistemic supremacy'. In Leung, S.Y. and López -McKnight, J.R. (eds.) *Knowledge justice: Disrupting library and information studies through critical race theory*. Cambridge, Massachusetts: MIT Press. pp. 73-93.

Msila, V. (2021) Entrenching the Soul of a University in Africa: A Search for a Liberating African Institution. *The International Journal of Diversity in Education* 22 (1), pp. 1-15.

Okech, A. (2020) 'African feminist epistemic communities and decoloniality'. *Critical African Studies* 12 (3) pp. 313-329

Pagowsky, N. & McElroy, K. (2016) *Critical Library Pedagogy Handbook: Introduction*. Chicago, Illinois: Association of College and Research Libraries.

Paraskeva, J.M. (2016). *Curriculum epistemicide: Towards an itinerant curriculum theory*. New York: Routledge.

Patin, B., Sebastian, M., Yeon, J. & Bertolini, D. (2020) 'Toward epistemic justice: An approach for conceptualizing epistemicide in the information professions'. *Proceedings of the Association for Information Science and Technology*, 57 (e424)

Patin, B., Sebastian, M., Yeon, J., Bertolini, D. & Grimm, A. (2021) 'Interrupting epistemicide: A practical framework for naming, identifying, and ending epistemic injustice in the information professions'. *Journal of the Association for Information Science and Technology* 72 (10) pp. 1306-1318.

Rigney, S. (2020) 'Creating the law school as a meeting place for epistemologies: decolonising the teaching of jurisprudence and human rights'. *Law Teacher*. 54 (4) pp. 503-516.

Santos, B. de Sousa. (2014) *Epistemologies of the South: Justice against epistemicide*. Oxford: Routledge.

Santos, B.de .Sousa, Meneses, M.P. & Taylor & Francis (2020) Knowledges born in the struggle: constructing the epistemologies of the Global South, Routledge, New York, NY.

Schucan Bird, K. & Pitman, L. (2020) ‘How diverse is your reading list? Exploring issues of representation and decolonisation in the UK’. *Higher Education*. 79 (5) pp. 903-920.

Shahjahan, R.A., Estera, A.L., Surla, K.L. & Edwards, K.T. (2022) ‘”Decolonizing” Curriculum and Pedagogy: A Comparative Review Across Disciplines and Global Higher Education Contexts’. *Review of educational research*. 92 (1) pp. 73-113.

Sundaresan, J. (2020) ‘Decolonial reflections on urban pedagogy in India’. *Area* (*London 1969*) 52 (4) pp. 722-730.

Thambinathan, V. & Kinsella, E.A. (2021) Decolonizing Methodologies in Qualitative Research: Creating Spaces for Transformative Praxis. *International journal of qualitative methods*, 20. pp. 1-9.

Tuck, E. & Yang, K.W. (2012) ‘Decolonization is not a metaphor’. *Decolonization: Indigeneity, Education & Society*. 1(1) pp. 1-40.

Tuhiwai Smith, P.L. (2012) *Decolonizing Methodologies: Research and Indigenous Peoples*. 2nd ed. London: Zed Books.

Universities UK, and NUS (2019). Black, Asian and Minority Ethnic Student Attainment at UK Universities: #Closingthegap. London: Universities UK, NUS.

Wa Thiong'o, N. (1992) *Decolonising the mind: The politics of language in African literature*. Nairobi: East African Publishers.

Wilson, K. (2021) *Decolonising library collections: contemporary issues, practical steps and examples from London School of Economics.* In Crilly, J. & Everitt, R. (eds) *Narrative Expansions: Interpreting Decolonisation in Academic Libraries*. London: Facet Publishing.

Woloshyn, A. (2019) ‘Decolonizing Desires and Unsettling Musicology: A Settler’s Personal Story of Researching and Teaching Indigenous Music at an American University’. *Intersections: Canadian Journal of Music/ Revue Canadienne de Musique*. 39 (1) pp. 41-55. Available at:

Zembylas, M. (2018) Reinventing critical pedagogy as decolonizing pedagogy: The education of empathy. *The Review of education/pedagogy/cultural studies* 40 (5), pp. 404-421.

Zhao, W. (2020). Problematizing “epistemicide” in transnational curriculum knowledge production: China’s suyang curriculum reform as an example. *Curriculum Inquiry* 50(2) pp. 105-125.

Diversifying the curriculum in Advanced Clinical Practice – strategies for teaching Minor Illness and phenotype

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Abstract

Healthcare trends have progressed alongside complex and diverse health needs. The United Kingdom has a multicultural population with various phenotypes of skin. This multicultural population requires healthcare workers to be trained and clinically competent to care for all skin phenotypes. While nursing educators have recognised the need to develop nurses with the clinical skills to assess and diagnose clinical conditions and skin phenotypes, there are concerns about the traditional pedagogical approach's ability to deliver these educational outcomes effectively. The traditional pedagogic emphasis is on learners acquiring knowledge and skills from positivist, factual, empirical knowledge. In this approach, the teacher's knowledge is based on inflexible, clinically biased nursing epistemologies which do not consider multicultural relevance to current clinical practice. The foundational knowledge of human bodies and diseases is limited to the white skin phenotype, a premise for implicit educational bias. This study will explore the Instructional System Design (ISD) of a culturally responsive pedagogy approach to teaching Minor Illness and phenotypes. The implication is that student understanding of subject matter may also be consistent with what the students are exposed to in a clinical situation. The findings will assist nursing educators in adopting ISD theory to diversify the planning of their lessons to include multi-specific considerations in nursing education.

Keywords: diversity, decolonisation, university curriculum, higher education transformation, pedagogy, instructional design theory, nursing education and phenotype.

Introduction/Literature review

Traditional Nursing Theories

Traditionally the epistemology of nursing education has a strong foundation in theories that believe in the cognitive needs of learners based on their experiences and evidence-based research (Selanders, 2010). This learning concept came from Cognitive learning theories (Piaget, 1952; Bruner, 1966) and Behaviourist learning theories (Pavlov & Thorndike, 1911; Skinner, 1954). Although these theories are generally purported to have no scientific basis, nursing education relies heavily on their neuromyth suppositions to educate nurses (Rousseau, L. (2021). Value was placed on behaving in a certain way consistent with the environment and hiding thoughts and behaviours (Fig 1). This condition was viewed as positive but led to a lack of congruence as the individual was hemmed from being themselves thus preventing growth (McComark et al., 2011).

In practice, learners assumed a passive role while acquiring new knowledge in their new environment (Figure 1). Learners learnt from their unique experiences and constructed new knowledge based on the foundation of what learners already knew. Specifically, these theories significantly influenced nursing problem-based learning in areas such as simulation (Burke & Mancuso, 2012). The behaviourist approach viewed learners as passive participants who did not contribute but instead adopted a change in behaviour consistent with their learning environment through pragmatic observation (Sensory memory) (Fig 1) (Weissmann et al., 2006). Learners were not encouraged to think critically and were rewarded for following a set of instructions. These theorists viewed nursing education as a system of learning and acquiring knowledge, skills, and attitudes (Myrick & Tamlyn, 2007). When the learning environment is stimulated, passive learners adopt cognitive behaviour such as memorising. Memorising becomes a valuable process for learners to remember information. Through the process of rehearsing, the learners develop long-term memory, which can be retrieved when needed to solve similar problems (Fig 1)

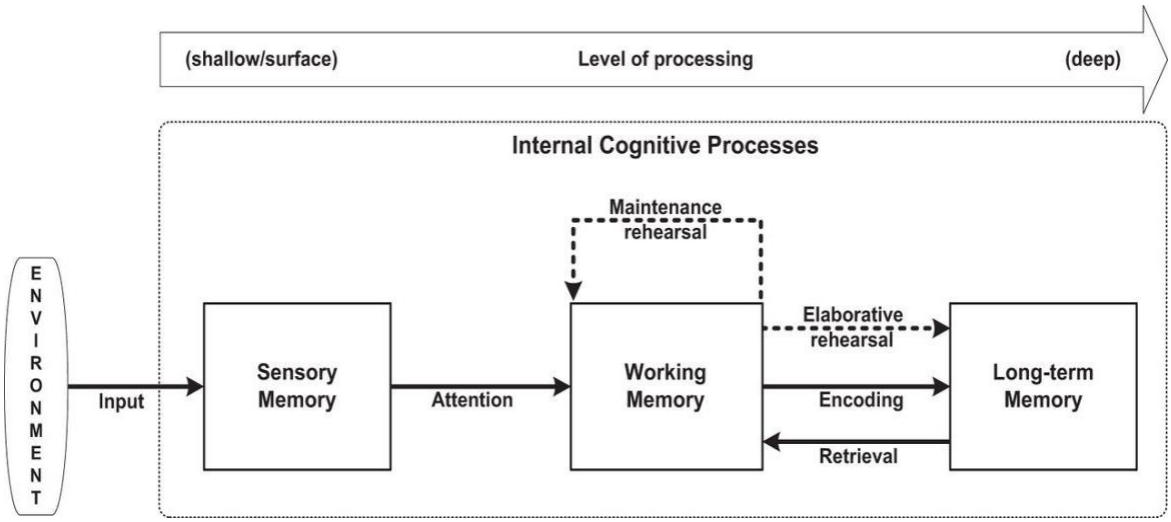


Figure 1: *Khalil & Elkhider (2016)*

Contemporary Pedagogic Theories

There has been a shift in nursing education theories heavily underpinned by educators' understanding of the pedagogical approach to learning in recent years (Rao, 2019). Person-centred care by theorists such as Rogers (1951), have influenced and shaped contemporary nursing. Rogers (1951) moved away from traditional ideological theories and proposed a person-centred care approach based on interactions with others. This humanistic concept of respect for others promoted an environment where people had love, self-worth, and respect for others (Fawcet, 2021). Person-centred theories focussed on relationships and encouraged care partnerships rather than passive learning. The result was mutual respect and understanding, leading to self-actualisation (McCormack et al. 2011).

The pedagogy approach focuses on the nature of knowledge and how it is taught and explores learning and how students and teachers learn (Horsfall et. 2012). The learners are

encouraged to be active participants, with interpersonal relationships integral to learning (Mackintosh-Franklin, 2016). Learners are valued as equal partners dismantling any power differences between the learners and their educators. This student-centred approach considers learners as lifelong learners and values their emotions and individuality (Mackintosh-Franklin, (2016).

The contemporary pedagogic approach encourages learner-centredness, where learners are responsible for their learning and facilitate and evaluate their learning according to learning domains (Allen, 2010). However, Horsfall (2012) suggests that educators refuse to relinquish power in some aspects of nursing education settings, such as in the clinical classroom, clinical teaching setting, or assignments and marking criteria. During such sessions, educators retreat to the traditional theory that emphasises the role of the teacher having ultimate power over nursing students. Greer et al. (2010) suggest that educators confuse their role and argue that their centre of power should be exerted in the course design, activity, and assessment.

Instructional Design Theory (ISD) (Figure 2)

There is a growing call for educational institutions to promote culturally responsive ISD (Gagne, Briggs and Wager, 1988) pedagogy in education and discard traditional influence in educational institutions which do not reflect the diverse student population (Smith, 2009). The ISD theory accentuates a comfortable and academically enriching environment for students from all backgrounds, ethnicities, beliefs, and creeds (Linnenbrink-Garcia et, 2016). ISD promotes inclusivity, a student-centred approach, and a sense of student well-being which recognises and is sensitive to the ability of their unique culture to strengthen, nurture and promote achievement (Reigeluth, 1999).

More importantly, decolonising the curriculum encourages a transformation of the medical curriculum to achieve an authentic image and lecture content representing the current multicultural population. Gishen & Lokugamage (2019) argue that curriculum changes alone are simplistic and inadequate to decolonise the curriculum. Instead, Nazar et al. (2015) propose a process of overhauling, transforming and modernising teaching materials to remove unconscious bias and provide equal opportunity for shared multicultural relevance.

The ISD theory also calls for a reform of education and individuals to foster a community to actively challenge the status quo and be active participants in implementing a culturally sensitive classroom environment (Linnenbrink-Garcia et, 2016). Similar to contemporary pedagogy, ISD promotes student-centredness at the heart of this theory but, more importantly, removes bias and promotes celebrated diversity and student culture (Linnenbrink-Garcia et, 2016). The ISD pedagogy also encourages learners to promote interprofessional connections between students and teachers.

ISD theory is also consistent with Herts learning principles, emphasising an evolution to learning devolved from an imposed curriculum. A curriculum design in which the principles

prioritise student learning to shape their learning and provide a research-rich, authentic learning experience. In this design, there is an opportunity for personalisation where students are informed of choices about their learning to prevent clinical bias (Barefoot and Russell, 2012).

Although contemporary pedagogy and ISD positively impact and create effective learning experiences, ISD further seeks to create learning experiences and materials that acquire and apply knowledge and skills to enrich students' cultural experiences through problem-solving (Brown et al., 2016). The ISD addresses the source of bias in teaching material content and resources for learning. Therefore, ISD theory enables teachers to create multi-specific learning materials to enrich the student experience and practice (Linnenbrink-Garcia et, 2016). ISD offers guidance on learning and developing in four methodological approaches: assessing needs (analysis), designing a process, developing intervention, implementing, and evaluating their effectiveness (ADDIE) (Fig 2) ((Yeh & Tseng, 2019).

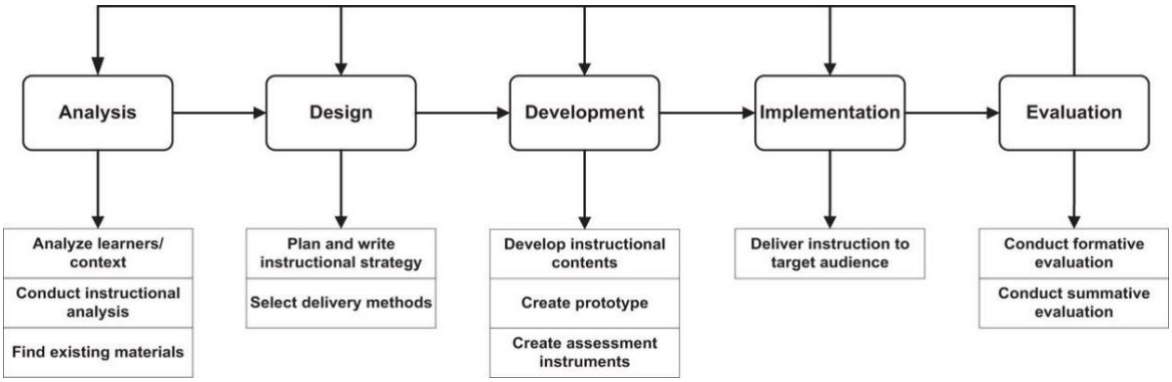


Figure 2: *(ADDIE Model phases) Khalil & Elkhider (2016)*

Assessing needs

The design orientation guides educators in explaining phenomena through cause-and-effect relationships rather than predictive or descriptive characteristics (Linnenbrink-Garcia et, 2016). The implication is that when the course content is designed to reflect all phenotypes, the effects will enable learners to develop clinical skills of assessing and diagnosing competency for clinical conditions in all phenotypes. The ISD theory develops content, experiences, and other solutions to support new knowledge or skills (Reigeluth, 1999).

Design and development

This section focuses on how the learning material is designed and developed and the mode of delivery. The lesson plan drafted should consider the topical content, the learner, the learning environment, and the instructional development constraints (Yeh & Tseng, 2019). The instructional materials should consider a teaching method to enable learning appropriate and efficient to meet individual student needs. The delivery mode choice is a student-centred approach (Linnenbrink-Garcia et, 2016). The role of the teacher is to coach and facilitate student learning and overall comprehension of the material. This approach has an interconnectedness between teaching and assessment and a continuous opportunity to

measure student learning. This method of delivering learning encourages learners' participation (Smith, 2009).

Implementation

In this phase, the process involves implementing instructional material to support learning objectives. The implementation principles adopt problem-centred instructional teaching methods to create an effective, relevant, interesting, and engaging learning environment in the real world.

Evaluation

Evaluation determines how successfully the learners are impacted. The measurable outcome for ISD is determined because compounding variables in real-life environments for learners are controlled to increase the chance of the desired outcome (Mercader et al., 2020). The ISD caters to the learners' needs, whereas traditional theorists emphasise what to teach, deviating from the learner's needs (Piskurich et al., 2015). Therefore, evaluations cannot be guaranteed.

Methodology

Pilot Study

Using the ISD theory, research from clinical resource representations of all phenotype skin from several medical resources was incorporated into Minor Illness teaching material to promote curriculum diversity in the course content. The phenotype skin condition representations were designed to promote inclusive learning and teaching resources for the learners. The piloted learning resource was designed to enhance student learning experiences and avoid clinical bias. The participants in the study were a teacher and 23 students from a Minor Illness module. A qualitative approach was used to collect data from participants. The qualitative questionnaire solicited students' perceptions post teaching. The questionnaire excluded participants' demographics to avoid identifying students. The teaching material design and content were made available to the student prior to the session. Students were not informed of the teaching approach nor informed of solicited feedback prior to the class session. Post-delivery of the session, students were directed to a section of the room to complete the questionnaire voluntarily. The questionnaire contained ten questions to explore students' views on the course content, delivery method, inclusivity, learning environment, teachers' presentation style, and any other concerns. Key themes from the feedback indicated a positive experience in all areas.

Presentation of findings

The data was collected from a focus group (23 students) to understand students' lived experiences after utilising an ISD theory to teach Minor Illness. Multi-specific, non-biased course content and teaching materials enrich the student experience. The course content design also facilitated the knowledge and skills required to assess all skin types (including phenotype skin). In order to avoid bias, the survey obtained information in two parts. Firstly,

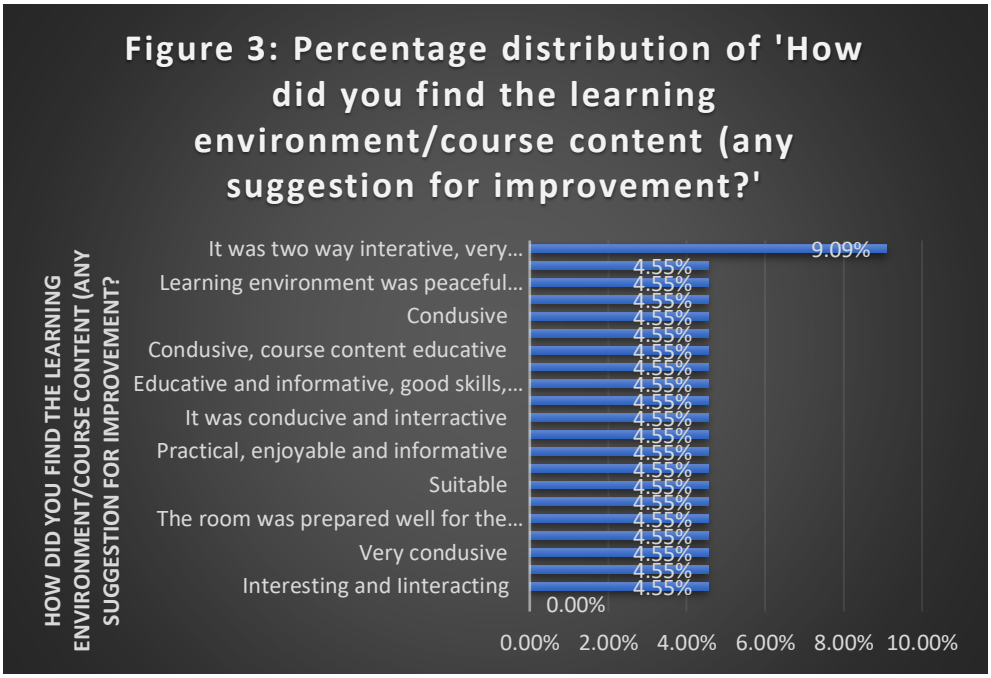
most of the questions (1-7) were standardised to allow participants to provide a yes or no answer. In the final part, questions (8-10) explored participants' perspectives through open-ended questions.

The completed questionnaire analysis revealed the following results:

All 23 participants agreed that the course encouraged student participation and inclusivity. The content met their expectations as they experienced more diverse images in the session, which raised their awareness of different skin tones, reflecting the phenotype patient population. All participants accurately identified wrong expressions used by clinicians to describe phenotype skin in worsened clinical presentations.

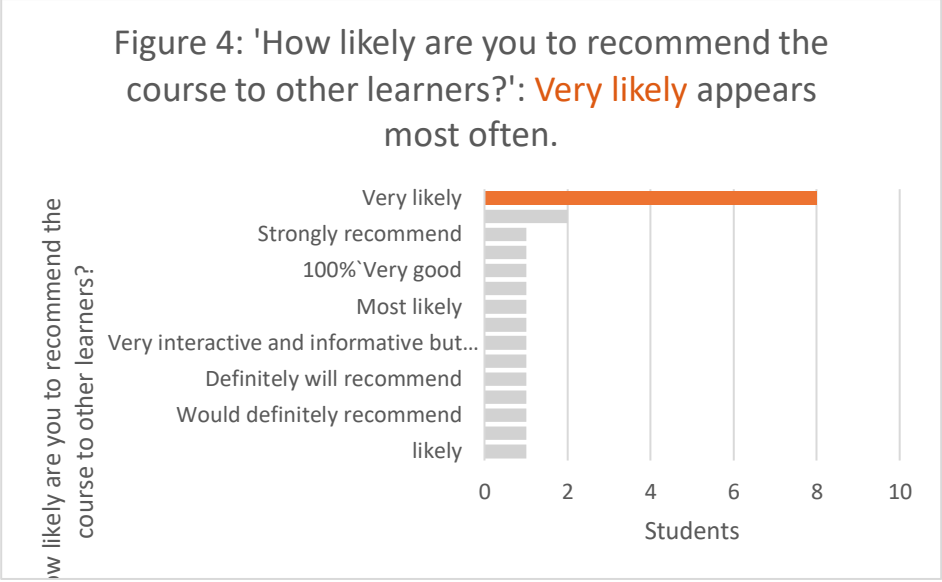
Learning environment/course content

The participant's perception of the learning environment and course content yielded the following results, 9.9% of participants reported that the session was a two-way interaction. There was an even sizeable distribution of 4.5% of participants who reported varied experiences such as the learning environment was well prepared, peaceful, conducive and the course content educative, informative, and interesting (see Figure 3).



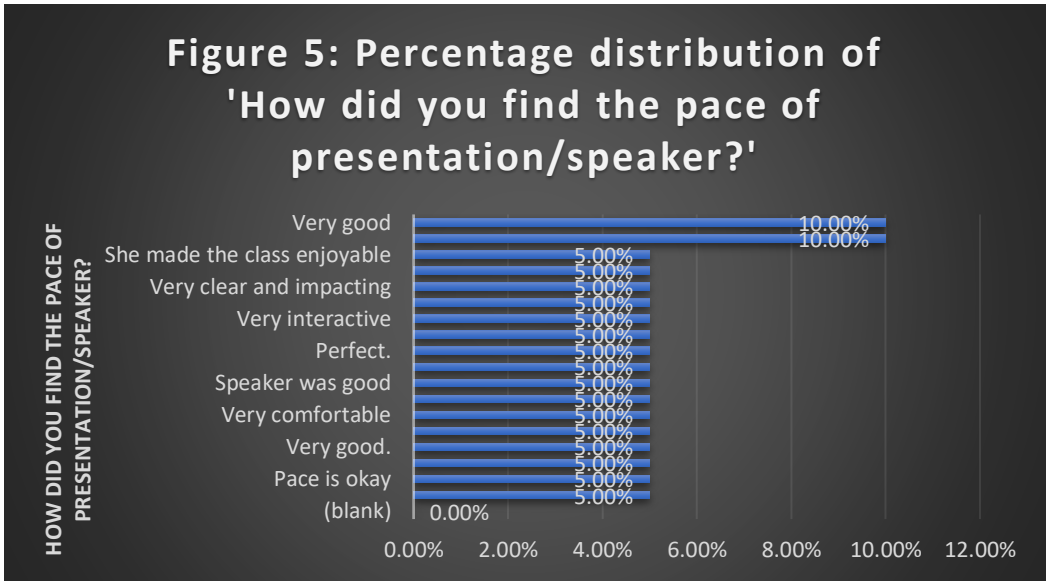
Recommendation of course to other learners

8 participants recorded “very likely " and 2 strongly recommended. The remaining 12 participants variously stated 100%, very good, most likely, definitely will recommend, likely and very interactive and informative, but would have preferred more time given to the session (Figure 4)



The pace of the presentation and the speaker

10% of participants stated very good. A 5% even proportion of participants also expressed different opinions such as easy to understand and friendly approach, very interactive, good pace, very comfortable, and perfect (Figure 5)



Context of key findings within existing literature

Teaching style

The teaching style relied on the social constructivist approach, which advocates for learners to learn through interaction, peers, and scaffolding (Karpickie and Blunt, 2011). This approach to teaching facilitated and enabled learners to gradually build complex knowledge from the foundation until they were able to assimilate (Van Merriënboer and Sweller, 2010).

Peer support developed a strong foundation that encouraged the learners to learn from each other. Through this process, learners engage in meaningful decisions to achieve critical awareness of the subject matter (Ashwin et al.,2015). In order to move away from the didactic theory of teaching where students remained passive learners (Audrey and Riley, 2019), the ISD included the principles of problem-solving, which promoted learners' participation, collaboration and engagement (Karpickie and Blunt, 2011).

Lesson Plan

The ADDIE principles were implemented using different teaching methods to create effective learning environments for the Minor Illness session (Dick and Carey, 2005). The Minor Illness teaching aimed to evaluate the application of an ISD theory in designing course content, enabling teachers to create multi-specific learning materials to enrich student experience and practice.

An initial assessment implied that the teaching should reflect a real-world healthcare system (Merrill,2002). Therefore, the lesson plan considered the topic's multi-specificity and the diverse student population that typically mirrored the current healthcare system. The challenge with creating a learning material suitable for the learner was the misconception that educators potentially might be biased. Trilk et al. (2019) claim that after educators acquire knowledge of a subject matter, educators may develop an implicit bias of assuming what may work or not for learners when teaching. This assumption is also unsuitable for learners who may have met the requisite foundational knowledge or experience within the healthcare practice. As a result, all effort was made to create a different teaching method centred on a learning environment that emphasised problem-solving, promoted learners' engagement, and provided instructions consistent with the real-world culturally diverse healthcare system to avoid the same bias (Jonassen, 2000).

The analysis of the previous learning material helped identify the problem of non-representation of phenotypes skin. Therefore, there was the need to redesign new learning material consistent with ISD to enable learners to develop the clinical skills of assessing and diagnosing all phenotype skin. This teaching content was more diverse for the learners' needs, consistent with the 100% confirmation of training content meeting learners' expectations and training materials having more diverse images reflecting all phenotype skin.

Lesson Design and Development

According to Yanchar et al. (2010), for the design and development process to be effective, the learning material should be content-rich, accommodate the learners' environment, and account for elements of the non-representation of multi-specificity situations. In the context of the ISD approach, the crucial aspect of employing an ISD was using a framework that created learning objectives which helped learners anticipate what to expect in the session and how the lesson would be taught, assessed, and evaluated (Jonassen, 2000). The main objective was to follow the methodological ISD approach (ADDIE) in teaching Minor Illness

to support nursing students to effectively educate and develop clinically competent care for all skin phenotypes. Based on the objectives of teaching Minor Illness in all phenotypes, learning domains focused on cognitive and practical teaching approaches, which were considered effective in checking learners' understanding of the subject (Karpickie and Blunt, 2011). The first part focused on an active lecture where students engaged and asked questions, and the practical session gauged students' application of the theoretical understanding of the subject. Bloom's taxonomy was a useful way to measure learning objectives that considered the practical application of the learners' skills (Armstrong, 2016).

Implementation stage

In the implementation stage, the nature of the subject matter meant that consideration should be made for the learners to apply the knowledge to practice. Since learners do not learn in a vacuum, the learning environment was created to represent learners' diverse healthcare experiences. Driscoll (2000) suggests that context influences are an inevitable part of a learning experience. Therefore, it was essential to provide manikins with all phenotype skins to influence learners' perspectives. When ignored, the learner will remain influenced by their experiences, and cultural constraints may arise in the ISD approach to learning. Furthermore, students' comprehension of the subject matter may be limited to discussions in the learning environment (Jonassen, 2000).

Another concern with the learning environment was the importance of applying the ISD theory to scaffold learning from simple to complex tasks. Providing an authentic learning environment avoided the learners' cognitive overload, a repeat practice assessment, and feedback (Van Merriënboer and Sweller, 2010). The session was divided into various tasks to avoid cognitive overload. The first part focused on simple scaffolding by introducing the concept of all phenotype skin and layers. Images and videos provided a bridge for cognitive and mental support to connect with the subject of discussion. The lesson was conducted in a simulation environment, and manikins were provided in phenotypes skin for learners to explore the learning task of physically identifying subject matter (Merriënboer and Sweller, 2010).

The content used various teaching formats, including pictures, videos, and manikins representing all skin phenotypes (Merriënboer and Sweller, 2010). The pictures and video showed a representation of Minor Illness skin problems in all phenotype skin for the learners to appreciate the differences in the presentation of different skin types. The problem-solving activities were designed to help learners develop knowledge and skills of different Minor Illness case studies representing all phenotype skin. Student survey responses regarding the implementation of the design and development question elicited positive results from the learners regarding the topical content, the learning environment, and the instructional development constraints.

Students' feedback

Evaluations play a significant role in improving instruction and learning materials to ensure they are aligned with learning goals and objectives (Schuwirth and Van der Vleuten, 2011). Although evaluation can happen at any stage, the focus of the evaluation considered the survey response (Henderson and Phillips, 2019). The survey was designed to gauge learners' understanding of Minor illness in phenotype skin and the delivery of the course in meeting the lesson objectives. Through the learners' lens, first-hand information about their experience, level of engagement, specific interest, and inclusivity was relayed to improve teaching (Henderson and Phillips, 2019). The feedback showed that the lesson enriched learners' knowledge in assessing Minor Illness and phenotype. The survey design focused not only on student development but also on how the educator transfers knowledge. Some of the questions solicited were:

- Did the training content meet your expectations?
- Did the session raise awareness of different skin types?
- How did you find the pace of the presentation and the speaker?

These open-ended questions from the survey captured the evaluation of students' attitudes, motivation, and instruction efficiency in the lesson design. Due to the high yielding positive feedback from participants, the response also confirmed that the ISD theory enabled the educator to create multi-specific learning materials to enrich student experience and practice.

Reflection on professional practice

On reflection, the educator is a novice in teaching and did not actively consider the influence of traditional theories on nursing education and practice. This module has enlightened the educator's knowledge and understanding of epistemological influences within the nursing practice that may not reflect the cultural diversity of learners in healthcare. Nursing education's embrace of a general pedagogical approach to teaching has greatly supported a generalist, culturally sensitive learning environment but may have limitations when applied to the nursing discipline. Due to the constant evolving levels of knowledge and research in healthcare practices, ISD theory would be ideal for supporting the nursing training curriculum to reflect diverse healthcare needs accurately. This could aid educators to consistently develop course content relevant to specific discipline sensitive theoretical influence, demonstrating the application to pedagogic scholarship and research.

Conclusions

In this article, various discussions of theories which have influenced nursing education have been discussed. The literature review has highlighted the inadequacies of traditional theories in teaching in the current nursing curriculum, emphasised by the non-

representation of some phenotypes in healthcare. In contrast, there is a diverse representation of learners in higher education. There is evidence that using empirical nursing theories that have no pedagogical bearing on learning isolates learners from being active participants. The remedy for these empirical nursing theories is to apply the methodological ISD approach. This approach enables educators to easily author educational material tailored to their particular educational settings and learners' needs. The survey results demonstrate positive findings in using ISD theory for nursing practice. The findings also provide a map for further studies.

References

Allen, S. (2010). The revolution of nursing pedagogy: A transformational process. Teaching and Learning in Nursing, 5(1), 33-38.

Armstrong, P. (2016). Bloom's taxonomy. Vanderbilt University Center for Teaching.

Barefoot, H, & Russel, M.(2012). The University of Hertfordshire's Curriculum Design Tool-Kit. Blended Learning in Practice.

Brown, G. T., Peterson, E. R., & Yao, E. S. (2016). Student conceptions of feedback: Impact on self-regulation, self-efficacy, and academic achievement. British Journal of Educational Psychology, 86(4), 606-629.

Bruner, J. S. (1966). Toward a theory of instruction (Vol. 59). Harvard University Press.

Burke, H., & Mancuso, L. (2012). Social cognitive theory, metacognition, and simulation learning in nursing education. Journal of Nursing Education, 51(10), 543-548.

Driscoll, M. P. (2000). The Psychology of Learning for Instruction, 2nd Allyn and Bacon: Boston.

Fawcett, J. (2021). Thoughts about models of nursing practice delivery. Nursing science quarterly, 34(3), 328-330.

Gagne, R. M., Briggs, L. J., & Wager, W. W. (1988). Instructional design. New York: Holt, Rinehart, Winston.

Gishen, F. S., & Lokugamage, A. (2019). Diversifying and decolonising the medical curriculum. BMJ.

Greer, A. G., Pokorny, M., Clay, M. C., Brown, S., & Steele, L. L. (2010). Learner-centered characteristics of nurse educators. International Journal of Nursing Education Scholarship, 7(1).

Henderson, M., Ryan, T., & Phillips, M. (2019). The challenges of feedback in higher education. Assessment & Evaluation in Higher Education.

Horsfall, J., Cleary, M., & Hunt, G. E. (2012). Developing a pedagogy for nursing teaching–learning. Nurse Education Today, 32(8), 930-933.

Iversen, I. H. (1992). Skinner's early research: From reflexology to operant conditioning. American.

Jonassen, D. H. (2000). Revisiting activity theory as a framework for designing student-centered learning environments. Theoretical foundations of learning environments, 89-121.

Karpicke, J. D., & Blunt, J. R. (2011). Retrieval practice produces more learning than elaborative studying with concept mapping. Science, 331(6018), 772-775.

Khalil, M. K., & Elkhider, I. A. (2016). Applying learning theories and instructional design models for effective instruction. Advances in physiology education, 40(2), 147-156.

Linnenbrink-Garcia, L., Patall, E. A., & Pekrun, R. (2016). Adaptive motivation and emotion in education: Research and principles for instructional design. Policy Insights from the Behavioral and Brain Sciences, 3(2), 228-236.

Mackintosh-Franklin, C. (2016). Pedagogical principles underpinning undergraduate Nurse Education in the UK: A review. Nurse Education Today, 40, 118-122.

McCormack, B., Dewing, J., & Mccance, T. (2011). Developing person-centred care: addressing contextual challenges through practice development.

Mercader, C., Ion, G., & Díaz-Vicario, A. (2020). Factors influencing students' peer feedback uptake: instructional design matters. Assessment & Evaluation in Higher Education, 45(8), 1169-1180.

Merrill, M. D. (2002). First principles of instruction. Educ Technol Res Dev 50 (3): 43–59.

Myrick, F., & Tamlyn, D. (2007). Teaching can never be innocent: fostering an enlightening educational experience. The Journal of Nursing Education, 46(7), 299-303.

Nazar, M., Kendall, K., Day, L., & Nazar, H. (2015). Decolonising medical curricula through diversity education: lessons from students. Medical teacher, 37(4), 385-393.

Piaget, J., & Cook, M. T. (1952). The origins of intelligence in children. Psychologist, 47(11), 1318

Piskurich, G. M. (2015). Rapid instructional design: Learning ID fast and right. John Wiley & Sons.

Rao, B. J. (2019). Innovative Teaching Pedagogy in Nursing Education. International Journal of Nursing Education, 11(4).

Reigeluth, C. M. (1999). What is instructional-design theory and how is it changing. Instructional-design theories and models: A new paradigm of instructional theory, 2, 5-29.

Rousseau, L. (2021). “Neuromyths” and Multiple Intelligences (MI) Theory: A Comment on Gardner, 2020. Frontiers in Psychology, 12.

Schuwirth, L. W., & Van der Vleuten, C. P. (2011). Programmatic assessment: from assessment of learning to assessment for learning. Medical teacher, 33(6), 478-485.

Selanders, L. C. (2010). Florence Nightingale: The evolution and social impact of feminist values in nursing. Journal of Holistic Nursing, 28(1), 70-78.

Smith, E. B. (2009). Approaches to multicultural education in preservice teacher education: Philosophical frameworks and models for teaching. Multicultural Education, 16(3), 45-50.

Trilk, J. L., Elkhider, I. A., Asif, I., Buchanan, A., Emerson, J., Kennedy, A. B., ... & Tucker, M. (2019). Design and implementation of a lifestyle medicine curriculum in undergraduate medical education. American Journal of Lifestyle Medicine, 13(6), 574-585.

Van Merriënboer, J. J., & Sweller, J. (2010). Cognitive load theory in health professional education: design principles and strategies. Medical education, 44(1), 85-93.

Verplanck, W. S. (1954). Burrhus F. Skinner. In Modern learning theory (pp. 267-316). Appleton-Century-Crofts.

Weissmann, P. F., Branch, W. T., Gracey, C. F., Haidet, P., & Frankel, R. M. (2006). Role modeling humanistic behavior: learning bedside manner from the experts. Academic Medicine, 81(7), 661-667.

Yanchar, S. C., South, J. B., Williams, D. D., Allen, S., & Wilson, B. G. (2010). Struggling with theory? A qualitative investigation of conceptual tool use in instructional design. Educational Technology Research and Development, 58(1), 39-60.

Yeh, H. C., & Tseng, S. S. (2019). Using the ADDIE model to nurture the development of teachers’ CALL professional knowledge. Journal of Educational Technology & Society, 22(3), 88-100.