Humanising Mathematics: Investigating the Impacts of Colonialism on Mathematics Students from the Global South

How does coloniality persist within the pedagogy of mathematics, and in what ways does this shape the education narratives of students with a link to the Global South?

Risandi Kodagoda

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Supervised by: Dr Stefania Lisai

School of Mathematics and Statistics

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Introduction

Hailed, somewhat oxymoronically, as a "universal language", mathematics, and certainly its pedagogy in Higher Education institutions today, stand seemingly isolated from the nuance of historical catalysts (Vithal et al., 2024)[i]. In particular, the influence of colonialism- which has greatly impacted the way that subaltern forms of mathematical knowledge have been misappropriated or eradicated (Schubring, 2021)[ii] to form what is now the Western guise of a "universal" subject. These alterations within the communication of mathematics have been a difficult issue to address as it forces us to interrogate this neat one-dimensionality that is so often taken for granted within the study of mathematics.

The impact of these effects is what is crucial within this study, with many critics suggesting it to be the cause of a certain detachment and disregard for 'students' meaningful personal connections' to mathematics (Visnovska et al, 2025)[iii].

This study aims to put forward a method to use this student voice to interrogate these impacts on students with a link to the Global South- as it is this demographic, in particular, who feel this cultural dualism within mathematics more poignantly. These findings will be used to identify the impacts of coloniality on this demographic of students in higher education institutions. This method will also be used to recommend introspective action the University of St Andrews can take to mitigate these impacts and make learning more equitable within its mathematics department.

Terminology

A note on terminology: by 'Western' we reference hegemonic epistemologies spread as a source of control by European colonial powers. We narrow the scope later to participants that have a link to a British colony, and we acknowledge that colonialism is not a homogenous force- and neither is its impact. The purpose of this label is not to undermine Western mathematical contribution, but rather to hold it in discussion with Indigenous, or subaltern, mathematics. By 'Global South' we refer to '*not just to the hemispheric south'* but *'a general rubric for decolonised nations located roughly south of the old colonial centres of power'* (Haug et al., 2021)[iv]. Furthermore, the use of 'coloniality' references the ongoing

impacts of colonialism on higher education institutions. Another important concept is the idea of "epistemologies" and "knowledge systems": these refer to the supporting assumptions and power systems that underpin the creation of mathematical results and determine how these results are presented.

Research Questions

The theoretical element of this study is focused on identifying the key elements of coloniality in mathematical education today, and the theory of how decoloniality fits into mathematical pedagogy. Subsequently, this study aims to provide a method, which will be implemented, to collect the views of maths students from the Global South - as it is these students that feel this dualism strongly. This investigates:

- To what extent colonialism impacts students from the Global South at the University of St Andrews through their qualitative perceptions of mathematics and its pedagogy
- The notion of 'universality' in mathematics and how this impacts what mathematics students deem 'maths' and a 'mathematician' to be
- Perceptions and experiences of indigenous/subaltern epistemologies within maths education
- Student opinions regarding potential action towards the 'decolonisation' of maths

Literature

Colonialism in Maths

Firstly, it is important to understand how coloniality is able to persist within the education system today before we theorise how this may impact students with a

link to the Global South. Le Grange (2019)[v] suggests that colonisation eradicated epistemologies from the colonised and reduced their ways of knowing to 'culture' and then subsequently offered Eurocentric form of knowledge as a source of power to these marginalised groups. This idea of Western mathematics being empowered is one that can be seen fundamentally through the systems of modernity/ rationality that they imposed. Notably the idea of the 'European paradigm of rational knowledge' which refers to how 'Cultural Europeanisation was transformed into an aspiration' through the colonial imposition of a 'mystified image of their own patterns of producing knowledge' which was placed 'far out of reach of the dominated' before it then trickled down to them 'in a partial and selective way, in order to co-opt some of the dominated into their own power institutions' (Quijano, 2007[vi]). It is important that a critique of the systemic remnants of this very idea is what prompted the decolonial movement within education.

Along with the notion of proof, these are ideas that, decolonial academic, C.K Raju (2018)[vii] rejects as they both oppose the more empirical systems set up by Indigenous groups (that are more culturally applicable), as well as imposing the systems of knowledge skewed by systems of power like the Catholic Church. This is an issue also discussed within decoloniality theory as, for students to engage in mathematical practice of this kind, they must shed their preconceived cultural notions about the world around them- and thereby subscribe to the notion of dualism. This alludes to 'modernity's dualist epistemological and ontological foundations' (Fúnez-Flores,2024)[viii]imposed by colonialism within mathematics which, historically, has been rather overt but persists today under the 'Eurocentric epistemology undergirding mathematics'(Fúnez-Flores,2024), particularly in the Global North.

Colonialism has also generally changed the pedagogy of mathematics by limiting access to mathematics education as well as setting out clear hegemonic perceptions of who mathematics is for and who it is from- this was alluded to by Oxford's Mathematical Institute's 'World History of Mathematic' page[ix] which states that until recent decades mathematics has tended to revolve around a Eurocentric narrative which focuses on 'the works of the "great" white European men'. It is also evidenced by the fact that, during colonialism, the institutions of higher education were reserved to settlers while the natives that had access to schools were educated in Roman Catholic missionary colleges.

This is evidenced by the French protectorate of Morocco, which had 'a strict separation' between the French schools, for French settlers, and indigenous Arab schools. The latter were constructed in a way that students 'would not enable entry to French higher education' so that mathematical pedagogy there would 'remain restricted to a level that would not cause resistance from the Ulemas (an indigenous community)'. There was also a later decree which alerted the colonial officers that mathematical teachings at these Arabic schools should not be 'disturb learning the basic religious sciences' (Abdeljaouad, 2014[x]). This shows the tension between pre-colonial indigenous mathematical education, the colonial institutions and the 'politically intended differentiation of the colonial system' (Schubring, 2021). It also evidences the duality and cultural assimilation that the colonial systems of schooling bring about, this will be expanded on in the following section.

The general infiltration of colonialism into mathematical education brings about the concept of an "epistemicide" which is the slow devaluation of other ways of knowing. Le Roux and Swanson (2021[xi]) highlight that the mathematical methods that 'gave legitimacy' to this epistemicide were 'achieved through a control of subjectivity' and underpin 'the universal descriptive and (…) possibilities of measurement, geometry and probability'. This 'subjectivity' is a key concept in this section as it discusses who is in control of presenting mathematics and why maths is presented in the way it currently is. This is a tool also exhibited in the colonial movement within literature, to shift the focus of narrative to the subaltern individual to hold that viewpoint in discussion with the viewpoints of the hegemonic body. This in maths has historically been used as a 'lens' to alter how mathematics has been presented- this could, historically, include preferring to credit a mathematician from a colonial body over a mathematician from a colony who have reached the same result or omitting to credit ideas from colonies in the formation of mathematical results. Therefore, it is dangerous to use this 'universal descriptive' when describing results, even if the results themselves can be implemented and reached by different epistemological system, because it negates this subjective, colonial force that has been instrumental in the presentation of mathematics.

Examples of this in action can be seen in historical discrepancies in accrediting mathematicians from the colonies: classic examples are, the Leibniz numbers- which were first derived by Indian mathematician Mādhava of Sangamagrāma roughly three centuries prior - and the infamous Chinese remainder theorem-

which was coined by American mathematician Leonard Eugene Dickson to reflect the work of Sun Zi and Qin Jiushao. Here the mathematical work of subaltern academics is absorbed into the Western mathematical practice either uncredited or in a generalised way. While this may not be the case with all mathematicians from the Global South, it is certainly a common historical practice that should be acknowledged and subverted.

Coloniality in Maths

Although seemingly antiquated, this illustrates the risk of presenting mathematics as a Western- or universal- pursuit today when in reality it is a 'pan -cultural' (Bishop, 1994)[xii] one. This study is not trying to set out whether this is inherently more or less "effective" but rather contribute to the fact that it is an effect that cannot be ignored and challenges the fundamental one-dimensional view most harbour when it comes to mathematics. It also builds the culminative effect of causing a disconnect between mathematical pedagogy and subaltern students who must undergo a cultural assimilation to connect with mathematics (Hunter and Hunter, 2024)[xiii].

D'Ambrosio (1985[xiv]) echoes this sentiment stating that mathematics cannot be 'disengaged from the main expectations of a certain historical moment' as 'we should not forget that colonialism grew together in a symbiotic relationship with modern science, in particular with mathematics'. He then, similarly, argues that 'the universality of mathematics' is inaccurate as processes like counting and ordering are varied enough across culturally differentiated groups that they are differentiated from 'the Western or academic way of knowing them'.

This study focuses on the niche of mathematics students with a link to the Global South at the University of St Andrews; thus, it will recognise the 'universal' pedagogy in mathematics as a primarily Eurocentric one that stands to perpetuate this hegemony to students from the Global South. Visnovska et al. (2025) suggest that this rhetoric stands to de-incentivise students that may already be marginalised, and thus negatively impact their development within mathematics due to a 'dehumanisation' of the content, which inhibits the content from helping students engage with the world.

Proportionally, much more scholarship has been done in investigating qualitative opinions of younger students with a link to the Global South studying

mathematics at school- with there being a frequent connection drawn between mathematics and intelligence and between mathematics and 'assimilation' (Hunter and Hunter, 2024) or sometimes even 'whiteness' (Gargroetzi, 2024)[xv]. Some critics suggest that, due to its connectedness with colonialism: 'On many levels, mathematics itself operates as Whiteness' as minority students 'have experienced microaggressions from participating in math classrooms' which is described as an environment where people are 'judged by whether they can reason abstractly' (Gutiérrez, 2017[xvi]). This is why the focus on students from the Global South in Higher Education is imperative as the duality that this 'assimilation' brings about is often an unconscious factor in their learning and connection to mathematical content and perception.

In the Global North there is evidence to suggest that coloniality can be pushed into racialisation (Bullock, 2024)[xvii], evidenced by the fact that 17.3% of Black and Minority Ethnic (BAME) students in the UK receive a first in their degree, compared to 36.1% of white students (2023)[xviii]. Furthermore, Ingram et al. (2020)[xix] suggests that ethnic cultural and social ideas play a part in these attainment gaps within mathematical subjects in higher education- and how the focus should remain on the 'teaching and learning of mathematics at university'. The Royal Statistics Society (2025[xx]) also recently found evidence to suggest that the odds of ethnic minority (BAME) researchers in the engineering, mathematical and physical sciences being successful in a funding application is around 32% lower than their white counterparts. When successful, this demographic of researchers is less likely to apply for as much finding as their white counterparts: with them expected to apply for, and receive, 90p for every £1 of their white peers.

While this can be taken as prima-facie evidence, it is a clear gap in mathematical attainment that cannot go ignored, and - if done constructively- decolonialising mathematics could ease the disconnection these students may face toward mathematics in higher education institutions. This does not negate the fact there could be other contributors to this gap such as socioeconomic background, but this is beyond the scope of this paper.

Therefore, while the predisposition for universality in mathematics identifies the fact common mathematical findings can be reached, it negates the need for any kind of nuance for the fact that different cultural bodies of students can engage, or be impacted by mathematics, in different ways. Thus, the ability for these cultural contortions to take place cannot be addressed without first

acknowledging the wider issue of the of mathematics being perceived as 'fixed, politically neutral, and value-free' (Peralta , 2020)[xxi] - which is a facet that will be addressed in the methodology.

On Decolonising Maths

This links on to the notion of decolonising mathematics being an ongoing process by which we interrogate the idea that Western ontologies are the only ways of learning (Walsh, 2018)[xxii] mathematics and hold this form of pedagogy in discussion with other Global forms of mathematical knowledge. This process involves questioning our underlying perceptions of what mathematics is and who it is for, in an effort to 'humanise' it and thus resist the duality imposed by the aforementioned 'cognitive imperialism' (Huencho, 2023)[xxiii]. This has been recognised by regulatory bodies like the UK's Quality Assurance Agency (QAA) who have responded by suggesting in a Subject Benchmark to shift the focus to 'a (mathematics) curriculum that (is) multicultural and contextualised', and 'informed by the student voice' (QAA, 2023)[xxiv].

Resistance to decolonialising maths may stem from concepts such as 'epistemic fragility'[xxv] , which Skopec et al. (2021) theorises explains the critical reception brought about as a response to the ideas of 'perceived meritocracy, centrality, authority, individuality and objectivity' that decoloniality invites. Another point of resistance is what some authors deem the "opportunity cost", which entails the prioritisation of decolonial content amongst mathematics content. This is a trickier issue to address as it deals with the question of what extent of decolonisation is both realistic and needed within universities in the Global North- which is a point of contention between academics. The best way to gauge this, however, is by using the perspectives of the students that these impacts- thus the methodology could also potentially help inform what the most pressing concerns are to students regarding coloniality within maths pedagogy.

Methods of decolonising mathematics have long been proposed with the key focus being in decolonising the history of mathematics, the philosophies that undermine them. The ideas of applying more cultural example and figures as well as providing more context when teaching mathematics at a university level are frequent suggestions. Globally, however, academics from the Global South have been suggesting educational reforms to make maths students more connected with their culture within classrooms. Hunter and Hunter (2024) describes the

inaccessibility of mathematics education as something students must surrender cultural values to, and something that is ultimately inapplicable to the future lives of the students. Thus, at its core the focus of decolonialism in maths lies in the ability to connect students and mathematical pedagogy in Higher education institutions to culture and their future lives.

This is built on by the work of Frankenstein (1983[xxvi]) who coined the term 'critical maths education' to encapsulate the need to use mathematics as a tool 'learned in the context of working on applications' which challenge the contradictions involved in supporting hegemonic ideologies. This could be utilised in actualising the QAA's suggestion in their finalised benchmark that 'students should be made aware of problematic issues in the development of the MSOR content they are being taught, for example some pioneers of statistics supported eugenics, or some mathematicians had connections to the slave trade, racism or Nazism' (QAA, 2023).

Bishop (1990[xxvii]) adds to theorising the dualism experienced by these students by maintaining how 'to decontextualise, in order to be able to generalise is at the heart of Western mathematics and science; but if your culture encourages you to believe, instead, that everything belongs and exists in its relationship with everything else, then removing it from its context makes it literally meaningless'.

D'Angelo's proposition of ethnomatics was formed fighting this generalisation. This is a branch of mathematics that lives in the intersection of culture and mathematics to help students recognise mathematics as a tool in shaping their everyday lives and cultural identity. Ideologically, it 'recognizes, in every corner of the planet, the different emergence of perceptions of space and time and the techniques of observing, comparing, classifying, ordering, measuring, quantifying and inferring and, as consequently, different styles of abstract thinking' while maintaining there is 'no contradiction' with this branch of mathematics and the 'universally accepted (…) Western mathematics'. This is an example of the decolonising process in action as it interrogates the universal descriptor previously mentioned.

Ultimately, the decolonial response to the effects of colonialism on maths remains in approaching 'intellectual decolonisation (…) in a reflexive manner' such that we avoid 'poorly theorised' and 'tokenised' attempts at decolonising curricula (Moosavi, 2020)[xxviii]. Moosavi's recommendations echo the sentiments of other decolonial critics to engage with decolonial literature from the Global South;

recognise the amount of work within decolonising a subject by acknowledging that it may not be possible; avoiding essentialising the Global South; and avoiding 'nativist decolonisation'.

Decolonialism, in practice, aims to listen to these students and address their needs within the pedagogy of mathematics, in a HE setting this is much more restrictive, but giving students the power to start to voice their experiences is a good start. Furthermore, the view of mathematics as something connected to both historical nuance and future, real-world impact is highly valuable in furthering this humanised lens of the subject. This, along with the theory highlighted above, is crucial when proposing the method (and collecting perceptions) to investigate impacts on students from the Global South in Higher education today.

Identifying a Gap in the literature

Brodie (2016[xxix])argues that 'universities must do explicit identity work with their students' and maintains the importance of exposure to concepts like ethnomathematics and critical mathematics. This is another important concept as it maintains Freire's (1970[xxx]) position that education is an inherently political pursuit and that institutions have a duty to not be neutral as 'washing one's hands of the conflict between the powerful and the powerless means to side with the powerful'.

This cannot be ignored, as for all students to get to an equitable point where mathematical pedagogy can start to be equally accessible, these viewpoints must be considered and be prioritised. This means we cannot think of the impacts of colonialism as something that has been eradicated, and we must allow this problem the dignity of effort- as it impacts a great many mathematics students and the future of mathematics pedagogy and research. This also is a valuable chance for students that are not from the Global South to consider new experiences within mathematics education, and to also broaden their understanding of mathematics.

The importance of this study lies in the fact that, in the calls for decolonisation, the notion of decolonising mathematics at a tertiary level is only very recent. It is a unique area, as – unlike younger students - these pupils are ones that already

have strong ideas about what mathematics is and who it is for, to the extent that they have self-selected to pursue it at a higher education level. This is illustrated by the fact that the QAA's subject benchmark suggesting the decolonisation of maths has elicited some opposing critical opinions from academics that stand fixed in the fact that this action should not be taken.

It is also a very important demographic as these are the students that will go on to inform further mathematics research as well as form the next generations of teachers in mathematics- and in turn passing down their notions and perceptions of maths to new generations. Therefore, any unconscious biases they harbour about mathematics may influence another generation of learners. Thus, it is crucial to look at their experiences and propose how colonialism may influence the pedagogy of mathematics, especially in the diverse environment of a higher education institution like the University of St Andrews.

This project aims to devise a method of investigation that listens to their knowledge, experience and biases to identify impacts. And then apply decolonial theory to mitigate the identified impacts on students from the Global South, to ensure that all students of mathematics a tertiary level can feel connected to mathematical pedagogy and understand it as a two-dimensional subject.

Methodology

This methodology follows from our findings in the literature review phase and is the intended process for an adjoining study. The intention of this project was initially to conduct these interviews but complications regarding the ethics system meant that data collection will be pushed forward into a resulting research project which will focus on the collection and processing of this data.

The focus will fall on student perceptions and their own experiences- and not on predisposed knowledge of the theory of coloniality or decoloniality within mathematics. Within the literature, a reoccurring way of investigating these notions these notions is through semi-structured interviews- which is here adapted for mathematics students with a link to the Global South at the University of St Andrews. It is important to note that, since these interviews will be advertised and self-selecting individuals will take part, several ethical

considerations must be taken for the implementation of these interviews. As the study gains qualitative opinions, it is imperative that it abides by the university guidelines on ethics and data protection. This includes making sure that participants are given enough information to give consent meaningfully- but not enough to lead them to answers. Also, the bias of looking at the qualitative data must also be acknowledged, as we are looking at the findings through a decolonial lens, with our research questions in mind. Data collection is a future area of work, starting with the demographic mapped out for this study within the university and then extending to mathematics students from countries colonised by British Colonial powers (unrestricted to just the University of St Andrews).

Preliminary Stage

Firstly, a preliminary stage, where we collect demographic information, will be used in the form of a Microsoft form. The aim to complete around 7-10 interviews, as this is both realistic as well as enough material to sufficiently analyse. This form will inform our selection process for the participants (if there is an excess) or it will ensure that participants are in line with the inclusion criteria of the study (over 18 years of age, with a link to the Global South, a student of a joint or full degree at the school of mathematics). This data will be securely stored, meaning it will only be available to the researchers and will be pseudonymised after the interviews take place. This ensures that if participants withdraw consent their information and interview data can be sufficiently removed from all leading work.

Interview Questions

The crucial part of this method is the thematic focus of the questions during the interviews. The first of three stages involves, once making sure informed consent is given for the study, the 'Background' section. This will focus on the participants' background as a maths student and their perception of mathematics. It will start by exploring why they chose to study maths at a tertiary level and how they have been taught mathematics throughout the course of their education- and if that differs if they undertook their education in another country. This aims to probe their experiences with mathematical pedagogy and teaching and to see if there are obvious structural impacts of studying mathematics in the Global North as a student with a link to the Global South. This then moves into an exploration of what they think mathematics is, and who it is set out for. This will test if their perception of mathematics is one that in informed by historical ideas

like colonialism or if it a strictly one-dimensional one. It will also be interesting if they have any underlying biases for who they perceive a mathematician to be- especially as a student who studies mathematics at university.

The second stage is 'Reflections on universality of mathematics and personal experiences', this will delve into their own experiences to see if they have encountered any indigenous ways of learning mathematics and (if they have studied mathematics somewhere else) if their preconceptions of maths has changed since being at university in the Global North. The role of 'teacher' will also be discussed in this section to see how central these concepts are to students in Higher education; this is a chance to fully explore this older student demographic and find out what meaningful change may look like. It will also touch on representation and access within mathematical education and if this affects their sense of belonging, which could be circular to their preconceived notion of mathematics from the first section. This will vary between participants that have studied in the Global South and those that have not, so the semi structured nature of the interviews will allow for this section to best investigate how 'connected' these students feel to mathematical pedagogy within the Global North. This will help to see if the dualism detailed within decolonial literature is something evident within the mathematics department at the University of St Andrews.

The last stage will be about 'Action' and change. This will start in a hypothetical fashion in asking students if they could change one thing about mathematical pedagogy at university what it would be. Then, in line with other student-led decolonial efforts in mathematics like the one at Durham University- probing what students can/should do about coloniality in mathematics education. It would also be interesting here to see what would deter students from acting on the decolonial stimulus, and if they think it should be acted on.

Data Processing

The results from the interviews will be transcribed and pseudo-anonymised, this will ensure that the raw data will be handles without bias. Qualitative analysis will then take place on these transcripts through software such as Nvivo. This entails coding each transcription and grouping them based on common themes. Here each section of the interview questions provides a rough guide, but any reoccurring notions or any reaction to common questions can also be grouped together at this stage. These codes will inform what the impacts of coloniality on

students from the Global South are and the final theme of questions will inform any recommendations for action the university can take.

Conclusion

This methodology will hopefully form a part of an important topic of discourse and help push the decolonisation of mathematics from theory into action. It is important that, in the interest of all students, decolonising mathematics- an endeavour that has been going on for decades in the Global South- can be recognised and acted upon in the Global North. With institutions like the QAA and Durham University's actions leading the way, it is crucial that the University of St Andrews and all higher education institutions in the UK, interrogate this notion and its effect on their mathematics students with the utmost care, to spark un-tokenised change. Ensuring that both university maths students and academics alike are being made aware of these concepts and have the tools to question them is vital, as they can directly inform and humanise the way that other people can connect with mathematics in the future. In practise, this method will also help to critique how mathematic pedagogy is empowered and acknowledge that structures, like colonialism, are not static- but rather ideas that evolve and continue to impact students. This two-dimensional view of mathematics is one that must accompany the decolonisation of maths for this issue to be meaningfully explored, in order to make the mathematics departments of Higher Education Institutions in the UK a more equitable place for all students.

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