

Epistemic justice during a global pandemic: Transforming curricula and pedagogical practices to improve student experiences of innovation studies

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Abstract

Current pedagogical approaches to science and technology policy studies in southern African universities may fail to provide students with the necessary capabilities to be effective as innovation policy practitioners. This study investigated whether consideration of epistemic diversity and the situatedness of knowledge could enhance student outcomes in terms of agency and self-efficacy. A pedagogical intervention was designed and implemented for a postgraduate course in engineering economics, following which the students rated their experiences through an online questionnaire. The COVID-19 pandemic partly disrupted the intervention, but also accelerated the use of blended learning as a means of mitigating the harmful effects of the consequent lockdown. The study revealed that most respondents felt that the intervention had helped them to feel more confident, respected and included. However, blended learning could not prevent the stressful experiences due to forced sheltering at home. The results support the importance of finding innovative ways to transform curricula and teaching methods in science and technology studies. Pedagogy based on the principles of epistemic justice, essential to ensure that students from different backgrounds have equal opportunities for personal growth, is challenging under remote learning conditions.

Keywords

Curriculum reform, decoloniality, epistemic justice, higher education, innovation studies

Introduction

The generally slow progress in the social and economic welfare of citizens within the Southern African Development Community (SADC) countries, now exacerbated by the COVID-19 pandemic, is a major and ongoing concern (World Bank, 2020b). At a national level, a number of reasons have been identified for the slow economic growth, including the undermining of public institutions as a consequence of corruption, the general lack of skills, and weak financial markets (Bhorat et al., 2017; Seekings and Nattrass, 2015). In classical economic terms, there are not the financial, institutional or human resources necessary to further develop the SADC states.

This slow rate of economic growth is starkly visible when compared to a basket of countries that were politically liberated at about the same time as South Africa and were able to benefit more fully from the liberation dividend (Sharma, 2014) (see Figure 1). Of particular relevance to this special issue, the low level of higher education within the region has also been cited as one of the more significant factors hindering the region's economic development (OECD, 2017), and, given the limited outcomes in terms of innovation performance, the same comment could be applied to innovation studies, or more broadly science and technology studies.

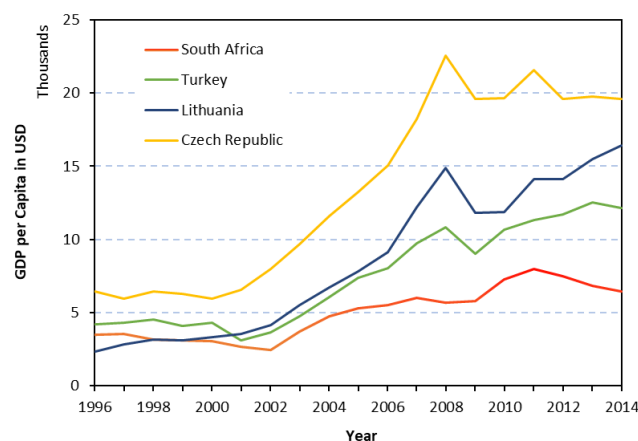


Figure 1. Growth in GDP per capita for selected countries

Source: World Bank (2020a)

This article begins, then, with the assumption that the teaching of innovation policy, more broadly defined as the practice of innovation studies, needs to take at least some responsibility for the faltering levels of innovation and economic development. It asserts that such studies must adopt a more situated approach towards innovation policy, both in terms of curriculum content and pedagogy. In an example of how the imperative of situatedness can be addressed, it reports on a study covering reforms to content and pedagogy, guided by insights from theories of epistemic justice (Fricker, 2007), public-good higher education (Walker, 2018), capability (Bajmócy and Gébert, 2014) and decoloniality (Ndlovu-Gatsheni, 2015; Ratele, 2019).

Reforms to pedagogy and curriculum content are also essential to the realisation of the broader goal of social justice and the development of citizens who can participate effectively and ethically within their communities and countries. As recently articulated by Walker (2019), “the choices we make about higher education are also choices about what kind of society we wish to build”. In this article, the results of such reforms to the presentation of a postgraduate course in engineering economics are presented. In Section 2, the background literature on the topic is reviewed. Section 3 presents the research approach. Sections 4 and covers the results and the discussions thereof, respectively.

Background

The Role of the Public University

Public universities are central to the development of human capabilities (Walker and Fongwa, 2017: , p6). These capabilities allow citizens to exercise agency and participate fully within their communities, thereby experiencing the benefits of social and economic freedoms. This role is understood to act through the two separate outcomes of an instrumental benefit and a social justice value. Higher education empowers their graduates with market-ready skills and expertise, which can raise levels of innovation and economic participation (Fagerberg et al., 2010), but more

specifically facilitate private gain. Of equal importance but not as frequently stated, higher education should also deliver a social justice value, ensuring that students are mindful of the social context and responsibility which new knowledge affords (Walker, 2018).

The argument that higher education should be accompanied by a heightened awareness of the concomitant responsibility towards social and environmental justice may seem to be overburdening university graduates and postgraduates, who are probably already carrying significant student debt and whose main objective is employability rather than social change. The immediate aspiration of many students, especially those students from disadvantaged backgrounds, is to find employment and earn a living (Walker and Fongwa, 2017: , p 106). Education is perceived in instrumental terms, providing the means to economic well-being and social mobility.

However, it is broadly acknowledged that knowledge and power are inextricably linked (Foucault, 1980; Maton, 2014). Knowledge is neither homogenous nor neutral; it imparts agency and capability, allowing an educated person to participate more actively in public life and more directly influence the lives of others. Higher education and the public good, especially at public universities, must be closely connected, especially if the region is to reverse growing trends in inequality and injustice (Walker, 2018). This function of a public university is particularly relevant to the training of the state bureaucracy, which has been an essential part of the higher education mandate since its initial establishment of the university system (Castells, 2016).

The use of the higher education sector as a means of reproducing the concept of the public good, and warning against the adoption of an individualist ontology which constructs universities as places to develop human capital for enhanced productivity and competitiveness, assumes the legitimacy of the state to impose such values. As noted by Castells (2016), the university system is based on the statism, or the perspective that the state has a legitimate and necessary role in directing the higher

education sector. These claims are extended further in developing countries, where the developmental state is necessary in order to undertake deep-seated structural reforms and enable economic growth. In particular, expanding human capabilities, as argued in this article, has become central to a capability-centred theory of development (Evans and Heller, 2015).

In summary, the expansion of human capability is critical to development and the higher education sector can play an essential role in this objective. However, it is not just a question of establishing educational infrastructure; it is also necessary to consider the content and curricula of educational materials carefully. In the next section, we discuss the reform of curricula in a democratic and decolonised society.

Decoloniality

The core arguments for curriculum reform in South Africa, as outlined in this article, draw on two separate but interconnected areas in the literature; decoloniality (Ndlovu-Gatsheni, 2015) and epistemic contribution capability (Fricker, 2015). The former seeks to broaden and extend the decolonisation discourse beyond the goal of removing only the political and economic relations of colonialism, which depends on the exertion of colonial power over another nation. Decoloniality includes the removal of the more enduring power structures that include control of culture, language, identity, self-image, knowledge and epistemology, economic relationships and opportunities, authority and agency. The concept is more useful than decolonisation because it implicitly acknowledges and makes visible the disguised, veiled power relations that shape the post-colonial societies (Ndlovu-Gatsheni, 2017; Wa Thiong'o, 1992). As noted by Maldonado-Torres (2006:117):

By decoloniality what it is meant here the dismantling of relations of power and conceptions of knowledge that foment the reproduction of racial, gender, and geopolitical hierarchies that

came into being or found new and more powerful forms of expression in the modern/colonial world.

The dismantling of existing power relations should not lead to their replacement by a new set of exclusive and exploitative structures. The protection of transformed systems from the abuse of power by alternative epistemologies can be addressed if there is prior agreement on design principles which are based on the broader virtues of equality and epistemic justice (Fricker, 2007).

The latter is separated into the two areas of hermeneutic justice, and testimonial justice, where hermeneutic justice refers to the sharing of systems or frameworks for the interpretation and understanding of the world or a set of experiences in an open and collegial manner; and testimonial justice relates to the requirement that all ways of knowing should be acknowledged, respected and accepted as valid approaches to knowledge.

It is perhaps easier to understand the concept of epistemic justice by considering the opposite thereof, namely epistemic exclusion, through which certain groups of students are actively prevented from acquiring knowledge as a consequence of prejudice or dehumanisation. The epistemic transformation (changing conceptions of knowledge) that is central to decoloniality must change those aspects of the knowledge system that cause psychological exclusion, oppression and unworthiness (Boaventura de Sousa, 2014).

The challenge of disalienation is easy to state, but more difficult to operationalise. One approach, which underlies the idea of African-centred or South-centred, is to support and strengthen the situatedness of knowledge (Ratele, 2019: :150). The latter adopts the ontological view that the self is inextricably and recursively linked to environmental context. Environment conveys and constructs meaning for the mind, and vice-versa. In this sense, imposed or alien epistemologies cannot be

equated to situated knowledge because these systems lack a connection with place, and hence meaning. Their adoption induces feelings of alienation, inferiority and confusion.

Alienation and worth are linked to the concept of epistemic contribution capability, an extension of capability theory (Fricker, 2015). Capability starts with the fundamental proposition that the building of freedoms, itself an essential developmental goal, requires the exercising of agency. Agency is defined as the ability to act and depends on the dual influence of an individual’s internal capabilities and her context or conversion factors, which may include aspects such as the availability of public goods, class, gender and race. The net result of exercised agency, working from an established set of capabilities within a particular context or assemblage of conversion factors, is, hopefully, a number of achievements or what the theory refers to as functionings (see Figure 2) (Sen, 1999; Kaushik and López-Calva, 2011).

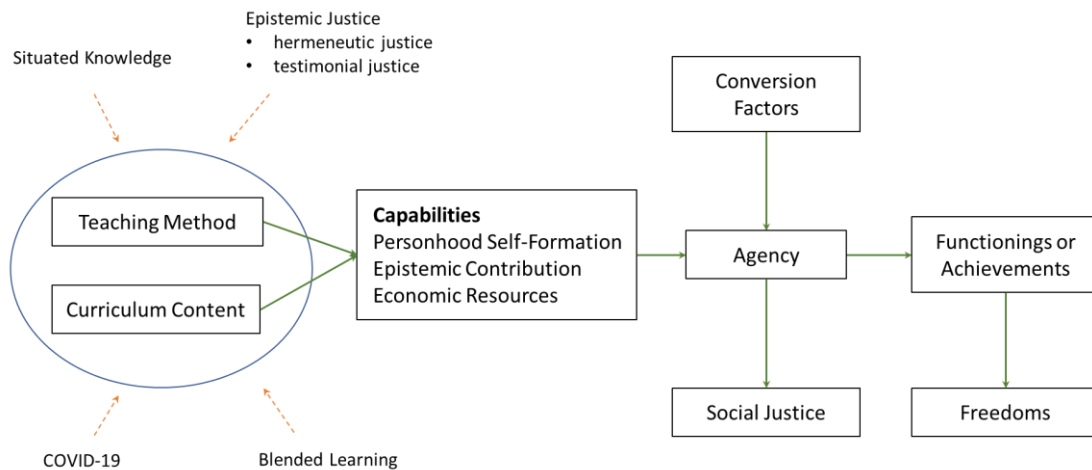


Figure 2. Steps in the development of freedoms based on capability theory

Source: Own data and Walker (2019)

Walker (2018) defines three separate capabilities, personhood self-formation; epistemic contribution; and a sufficient threshold of human resources. In this article, we are concerned with personhood self-formation and epistemic contribution capability. The former refers to the removal

of exclusionary practices and values that dehumanise certain population groups and allow all humanity to recapture agency or re-establish a strong sense of self-worth. Examples of personhood attributes which should become dominant in the process of developing this capability include self-confidence, compassion, empathy, solidarity, acceptance of complexity and diversity, a capacity for humanness and inclusionary ontologies (Walker, 2018).

Epistemic contribution capability covers the dual processes of receiving knowledge and giving knowledge. The articulation of epistemic contribution capability, loosely defined as the “capability on the part of the individual to contribute to the pool of shared epistemic materials” (Fricker, 2015: : p6), offers a powerful approach to the understanding and development of new solutions to the widely reported issue of campus alienation and dissonance.

The development of critical reasoning, an essential goal of university education at all levels, but particularly at postgraduate level, is ultimately a social and collaborative project which depends on the students' confidence in being able to engage in debate and share understanding (or misunderstanding) regardless of the consequences. The inclusion of all students within an epistemic community is essential for their personal development. We argue that the approach of epistemic plurality, and more broadly the search for epistemic justice, strengthens not only curricula but also student learning and engagement (Fricker, 2015).

Epistemic justice is itself divided into two separate areas of testimonial justice and hermeneutic justice (Dunne, 2020). Both terms are more easily understood in terms of their converse. The injustices experienced as a consequence of the action of others is often the focus. Testimonial injustice covers the situation in which the knower speaks with authority (delivers a testimony) but is not believed as a consequence of prejudice or stereotyping. Examples of such injustice include the

rejection of traditional knowledge based on the argument that it is not based on evidence, or the ideas of a young person being rejected since s/he lacks experience.

Hermeneutic injustice arises when a person is prevented from acquiring the analytical and articulation skills needed for contribution to a discussion (Dunne, 2020). Access to such skills may be restricted to elite knowers, leading to the hermeneutical marginalisation of a particular social group. In this section, two overlapping areas of the literature, namely decoloniality and epistemic justice, have been reviewed and discussed. Both areas were crucial in guiding the teaching interventions and changes to the course content in the module on engineering economics, which was presented in the first half of 2020 and used as a means to explore how some initial ideas of how attention to the development of capability can address problems of alienation and discrimination, and provide opportunities for testimonial justice.

The study aimed to answer the following three research questions:

- To what extent do the student cohort of this study perceive the epistemic intervention as empowering?
- To what extent does the cohort experience blended learning as reducing disalienation?
- Did the blended learning approach reduce potentially negative learning experiences during the COVID-19 lockdown?

Methodology

The population for the study consisted of a cohort of students registered for a module on engineering economics, which is presented as a core course within the programme on Honours in

Engineering and Technology Management at the University of Pretoria. This programme is designed to provide recent graduates, already holding a bachelor's degree in science or engineering, with knowledge and expertise in technical management and support, as may be required in workplace settings such as technology-intensive firms or technology-linked government departments.

The module itself is a single-semester course covering the use of financial indicators as a means of assessing the economic viability of engineering projects (Park et al., 2013). The subject draws on the broader theories of microeconomics and provides the students with the analytical tools necessary for calculating financial parameters such as internal rates of return, net present values of discounted cash flows, payback periods and cost/benefit analysis (Walwyn et al., 2015). Such techniques are widely used to guide investment decisions at a micro level, including decisions by individuals, within private firms and in government departments.

158 students registered for the course, of whom 71% were black African, 61% male and the average age was 22 years. Although this was not a measured parameter, it was apparent from the registered profile that most of the course students do not speak English as a home language.

Interventions

In broad terms, the teaching approach was organised so as to give the students the opportunity to present their own points of view and the reasons for their ways of knowing. As a means of ensuring wider participation, the lecturer structured a learning space in which different epistemologies, referred to as epistemic diversity, would be respected. There were online discussion groups, opportunities for online tutorial sessions (used by some of the students) and two coached assignments. The coached assignments were online tests with subsequent explanation of the answers, used as part of the module's formative assessment processes.

The two types of interventions which were implemented during the module, the one set aimed at enhancing capability and the second set based on the principles of blended learning, are shown in Table 1.

Table 1. Teaching interventions used in the module based on intervention type

Capability (personhood self-formation and epistemic contribution)	Blended Learning
Open book, problem-solving approach	Online synchronous learning (Zoom and face-to-face lectures)
Worked examples using Excel and its financial mathematics functions	Asynchronous self-work tutorials
Daily news items linking current events to the course content	Group assignment based on the evaluation of a project with a large capital expenditure
Application of financial calculations to students' context (local relevance)	Appointment system for online consultation, either in groups or individually
Conscious effort to be respectful of each student's 'way of knowing'	Several repeats of the formative assessment
Use of polling software to engage with the students and obtain feedback	Pre-recorded lectures and references to online videos/other relevant materials

The students were advised before the commencement of the initial lectures of the new approach. A short introductory note explained the open book, problem-solving approach, and encouraged the students to participate in the various initiatives so that they could derive full benefit from the active and blended learning approach. They were asked to download the polling software, familiarise themselves with spreadsheets and complete a pre-course tutorial.

Ethical Considerations

Ethical clearance for the study was obtained from the Engineering Ethics Committee of the University of Pretoria. A researcher in a different faculty administered the survey so that the questionnaire would not be perceived as being connected to student marks. The survey was administered after the course was completed so that students would not feel unduly obligated to participate. Respondents were asked for informed consent before the survey commenced, and their responses are anonymous.

COVID-19 and Lockdown

The initial lectures took place as planned. Shortly after that, the COVID-19 pandemic exploded and, on the 15th March 2020, the President of South Africa declared a national state of disaster with the immediate closure of schools and universities, and a ban on foreign travel. On the 26th March, a national lockdown was imposed, with severe restrictions on personal movement and economic activity. Individuals, other than those performing essential services, were confined to their homes; the sale of tobacco and alcohol was banned, and permissible retail activities were limited to food and medicine.

The impact of the lockdown on the activities of universities was considerable. The residences and campuses were closed, and the students were evacuated from university premises. All teaching and assessment functions were moved online, and special provisions were made for ensuring that students had at least some data connectivity. The possibilities for learning as a social process were immediately foreshortened and, the quality of synchronous tuition dramatically reduced. Many of the planned activities for this study, including the use of 'thinking aloud' and translanguaging, were not possible under the lockdown restrictions. Ensuring that students could learn and study became an urgent priority, and issues such as epistemic justice and personhood were side-lined. The COVID-19 pandemic greatly influenced the implementation of this research project. The lockdown is a

confounding variable, and the pandemic influenced the outcomes of the interventions. As a result, the questionnaire included explicit questions about student experiences of the lockdown.

Sample

The study used a quantitative approach to the assessment of several changes in the module. An online questionnaire was used as the data collection instrument, and a comprehensive sampling strategy was adopted. All registered students (158 students) for the specific course of relevance to technology management were sent the web address and requested to respond to the survey. The Qualtrics survey was distributed by a researcher in a different faculty to avoid ethical problems. Students should not have felt compelled to complete the survey due to the third-party distribution and could contact the external researcher with any questions or concerns. The survey was answered anonymously.

Instrument and Administration

The questionnaire was structured to assess the two main types of intervention as shown in Table 1, and a third construct to determine if the effect of the pandemic had been mitigated by the use of blended learning. In addition, one open-ended question was included so that more qualitative experiences of the intervention could be described. Participants were asked to rate statements on a four-point scale: *Not At All True* (1); *Not Very True* (2); *Mostly True* (3) and *Very True* (4). The option of *Not Sure* was included, and treated as missing data.

The Rasch rating scale model in Winsteps 4.5.0 was used to assess the internal reliability and validity of the instrument (Andrich and Marais, 2019; Linacre, 2020; Wright and Masters, 1982). The three constructs, capability, blended learning and COVID-19 mitigation, were checked for reliability using Cronbach's alpha. The coefficients in each case were 0.826, 0.777 and 0.754, respectively. Two items showed significant misfit, 13 and 18. As the questionnaire is exploratory and is considered a

pilot version, the items were retained for analysis. However, future versions would require the items to be revised or replaced. Person and item separation indices indicated that there were enough items and persons to measure the range of the constructs. The category, *Not At All True*, was not chosen for some of the questions, creating potential measurement bias. Future versions may require fewer categories or more respondents to assess the usefulness of the categories. The categories of *Not At All True* (1) and *Not Very True* (2) were collapsed, which improved category functioning. Evidence for the internal reliability and validity of the instrument was judged as appropriate and adequate for descriptive analysis.

Data Analysis

The current study takes an exploratory approach to the phenomena of personhood (self-esteem), epistemic contribution capability and decoloniality. As this is a preliminary study and the questionnaire newly designed, descriptive analysis of results is presented in terms of means and percentages. The open-ended question was coded, and the most prominent results are presented as counts with quotes from participants to support findings.

Results

A total of 51 responses were received, equivalent to a response rate of 32%. The capability construct (see Table 2) received the highest overall score, with respondents endorsing the items on average as 2.37 out of a possible score of 3. Blended learning generally received a high overall score as well, 2.50 out of 3. The use of blended learning to negate the effect of the lockdown on learning received a lower rating, 2.02 out of 3.

Table 2. Construct mean scores, standard deviation, minimum and maximum

Constructs	Linkage to Theoretical Framework	Mean	Standard Deviation	Min.	Max.
Capability	Epistemic justice and personhood self-formation	2.37	0.41	1.00	3.00
Blended learning	Agency through effective learning	2.50	0.34	1.83	3.00
Mitigating lockdown through blended learning	None, considered a confounding factor	2.02	0.47	1.00	3.00

Most items were highly endorsed, with participants agreeing that the intervention helped them to feel more confident, respected and that it was inclusive of their viewpoint, see Table 3.

Table 3. Responses to capability-linked questions

Capability for epistemic and personhood decoloniality	Not Very True	Mostly True	Very True	Not Sure
The course helped me build upon my existing knowledge of financial matters	6%	35%	55%	4%
Use of local material was relevant to my own experience and needs	10%	53%	35%	2%
I will be able to use the course work in my own life	8%	35%	55%	2%
The lecturer was respectful of my way of understanding the subject	10%	27%	61%	2%
The course helped us feel more confident by including our perspectives	18%	47%	33%	2%
The lecturer made a special effort to respect my point of view	2%	45%	49%	4%
The course increased my self-confidence to make financial decisions	6%	43%	45%	6%
I feel better about myself due to my experiences in the course	14%	41%	41%	4%
When the lecturer respected my way of knowing, I felt more in control of my learning	6%	47%	37%	10%

Capability for epistemic and personhood decoloniality	Not Very True	Mostly True	Very True	Not Sure
Polling software can help students be more engaged in the class discussions	2%	29%	67%	2%
Participation in the lectures helped me to understand and remember the content	10%	45%	43%	2%
The lecturer tried to explain important concepts in a way that I could understand	14%	45%	39%	2%

Most of the respondents said the statements were mostly true or very true of them. Only 18% of the 51 respondents felt that the course did not help them feel more confident by including their perspectives. A small percentage (16-18%) said they were not sure or that it was not very true that the concepts were explained in a way they could understand or that they felt better about themselves due to the course.

The findings of the blended learning questions show less consistent agreement by respondents. The lower endorsement of blended learning during the lockdown may be due to the impact of the pandemic and the difficulty of learning only from home (Table 4). Most of the respondents (>70%) said the blended learning approach, in general, was a positive experience and that they enjoyed relevant news stories and classroom examples. Students who responded to the survey also reported that self-work and pre-course work helped them learn and remember the course material. The majority of the respondents (86%) said that being able to choose how they learn through a blended approach helped them increase their course marks.

Despite the use of blended learning to offset or mitigate the effects of learning from home during the lockdown, two-thirds (58%) of respondents felt doing the group assignment was more difficult at

home and that their marks may have been affected. A quarter of the students (25%) felt unsure of how the lockdown impacted their assessment outcomes. Students were also more likely to say that the lockdown made it more difficult for them to participate in course activities (43%). Students were divided as to whether the alternative exam arrangement helped them complete the exam the way they would have done before the lockdown. Questions not related to the lockdown, such as self-directed learning, group work and the option to choose how to learn received higher overall ratings. Blended learning may not have been enough to counter the substantial changes brought about by the lockdown.

Table 4. Responses to questions associated with blended learning

Blended learning to promote self-esteem and local relevance	Not Very True	Mostly True	Very True	Not Sure
I enjoyed the worked examples we did in class	12%	43%	45%	0%
The daily news stories were fun	20%	25%	47%	8%
Using Excel as a modelling platform was useful for the students	4%	24%	73%	0%
The self-work tutorial contributed to my learning	6%	22%	73%	0%
The pre-course tutorial helped students to prepare for and remember the lecture material	10%	39%	51%	0%
The group assignment helped me to improve my marks	4%	20%	76%	0%
Blended learning, which let me choose how I learn, helped me increase my marks	10%	39%	47%	4%
Completing the group assignment was not more difficult during the lockdown	59%	22%	18%	2%
The Zoom meetings helped me learn successfully during the lockdown period	14%	35%	45%	6%

It was easier to complete the self-work tutorials during the lockdown	33%	33%	31%	2%
The lecturer's responses to my emails during lockdown helped me complete my course work	4%	33%	53%	10%
The announcements on clickUP helped me to learn during lockdown	10%	25%	57%	8%
Alternative exam arrangements helped me complete the examination at the same level as before lockdown	39%	18%	33%	10%
The COVID-19 lockdown did not make it more difficult for me to participate in course activities	43%	33%	24%	0%
My assessment marks improved due to the lockdown changes	59%	4%	12%	25%

The open-ended question asked participants if there was any additional feedback which they would like to share. Out of the 51 respondents, 22 wrote in more detail about their experiences of the intervention and the lockdown. Another three students sent comments via email. Table 5 shows the codes generated for responses as well as how many respondents mentioned the aspect in their feedback. Some students wrote paragraphs which contained several aspects, but counts represent one respondent mentioning the code. The codes were organised according to the lockdown impact, course experiences and pre-course preparation, as these issues emerged more prominently in the feedback.

Table 5: Open-ended responses

Aspect	Count
Lecturer Relationship	
Lecturer helpful, responsive and organised	6
COVID-19 Impact and Examination	

COVID-19 negatively affected exam preparation and performance	4
Design of exam problematic: length, ambiguity and technical issues	7
Course Experiences	
Online positive experiences: fewer distractions, enhances learning, enjoy Zoom meetings	3
Material responsive, supported individual growth and practically useful	4
More classroom time needed	2
Pre-Course Preparation	
Need an introductory course	4

The fact that six respondents describe in detail the positive experience they had with the lecturer could indicate that the congeniality of the lecturer may have created a halo effect for students who felt a rapport with the lecturer. This is a natural human phenomenon as we integrate learning experiences with the teacher. Experiencing a teacher or lecturer as accessible and personable could also be a facilitation of epistemic justice, if that is the experience of all groups for the most part. The role of the lecturer as a factor that reduces alienation requires more research, especially if one wants to disentangle the person from the intervention. An example of how respondents focus on the presenter as much as the content is illustrated by the following quote:

His personality, responsiveness and an attitude to go an extra mile for the student is an added plus [Respondent 22]

The negative impact of the COVID-19 lockdown on students emerged strongly in the open-ended question, and 11 students felt they had to describe in more detail how difficult the online examination made it for them to perform well in the course. The students felt that both their preparation as well as their performance in the examination was negatively affected by the online nature of the exam. Students described some of the particular difficulties:

I know for a fact that writing an exam on your bed does not necessarily encourage good results. [Respondent 3]

The lockdown I felt it made things even difficult to prepare for the exams as one would normally study at a library with minimal family disruptions. [Respondent 1]

The examination was perceived by seven students as being too lengthy and ambiguous, and students described the experiences as:

The online exams were a nightmare most of us did not finish the exams I wish were given more time [Respondent 14]

The online examination was too tedious to complete and download in the given time. [Respondent 17]

In the course experience section, there were three students who found online learning experience to be positive and one said that this type of learning was less distracting, while another enjoyed the Zoom meetings. However, it is essential to note that there were also students who, while acknowledging the positive aspects of online learning, were aware of the socioeconomic disparities such learning may reveal and aggravate:

Zoom meetings which also assumed that people have access to the internet at the time or the available data to stay in the meeting for the duration so people who had the resources to do so may have benefited [Respondent 3]

Four participants reported finding the course material and presentation style personally relevant and promoting of individual growth:

At a level challenging enough for me to broaden my thinking [Respondent 20]

Respondents also felt that more classroom time was needed as well as an introductory course to the material. This may point to the importance of in-person interaction as well as easing into new knowledge systems, especially for students from different ontological backgrounds. Barriers such as language and the use of technical language can be especially tricky for and require additional effort to address epistemic needs.

Most of us we have no background with financial management and we struggled with Excel as well [Respondent 14]

I personally struggled due to no financial background, English is not my language and combined with finance language it was worse [Respondent 15]

Discussion

Most of the students endorsed the capability items as being mostly true or very true for them, indicating that the students who chose to respond to the questionnaire generally felt that the course helped them with confidence, was personally relevant and engaging. While the majority of respondents felt empowered by the epistemic intervention, some students (about 20%) did not feel that their capability was improved by the intervention or felt unsure of the effect on them personally. The lockdown was especially challenging for many students, and despite efforts to use

blended learning to negate the negative experiences, many students (38-58%) felt that the lockdown was alienating and made learning more difficult.

The open-ended question revealed the complex nature of an epistemic intervention, especially when significant changes such as a lockdown abolished the use of teaching through face to face interaction. There were positive experiences of the materials, methods and even the online-only teaching. Most students felt that the lecturer did make a special effort to create agency and opportunity for them. Some students highlighted areas where additional effort is required, such as pre-course preparation to help students who do not speak English as a home language and who have not been exposed to the financial jargon used in the course. Students may also need additional help with software, such as Excel if they had not previously used it for course intended purposes. Students said that additional classroom time could help those who face barriers and improve personal empowerment, but this was especially problematic after in-person class interaction was suspended. Students who live in homes that contain distractions or demands, and who may not have resources for internet data are likely to have been the most negatively affected. Favourable home environments and access to data and equipment may have led to more positive experiences of online learning. There was a clear split in the answers of the questionnaire indicating that half of the students could manage the online learning and were not as negatively affected, whereas the other half felt disadvantaged by the changes or unsure of how the online learning would impact their course marks, leading to exam anxiety. Indeed, one of the participants described this in the open-ended question as "paralyse you and your confidence". The role of the teacher in implementing the principles of epistemic justice and disalienation emerged as an important factor in the course. A lecturer who is approachable, available, helpful, responsive and organised could be a key element in creating learning experiences which enable personhood and capability.

The current study is based on a small sample of postgraduate students and used an online questionnaire to which one third of the students chose to respond. There may be response bias present, for example, students who enjoyed the course may have been more willing to respond, and students with access to data and the internet may have had more opportunities to respond. Further studies will be important to validate the constructs and also to determine whether attention to personhood self-formation and epistemic justice can indeed improve the practice of innovation policy. Further arguments in favour of such studies are outlined in the next section.

Future Directions

Curriculum transformation has been an important topic for higher education in many countries, not only the Global South, since the 1960s (Schmitz, 1995; Hedges, 1996; King, 2006). At its most fundamental level, the full extent of this necessary transformation will only be realised once a whole set of normative assumptions can be revealed and countered, including assumptions about race, gender and capability. Widespread protests in the United States, following the killing of George Floyd, have highlighted experiences of persistent racism throughout the country, including in academia. As a result, there have been renewed calls for the diversification of curricula and an acknowledgement of the role of universities in perpetuating systemic racism (Roberts, 2020).

To some extent, this article shares the same logic and claims as this broader pedagogical discussion. It draws on the perspective that experiences of liminality as a result of substantive attempts to implement principles of epistemic justice are empowering and effective in developing human capability, thereby leading to economic freedoms. It acknowledges the importance of eradicating racism and stereotypes as a path towards the attainment of hermeneutic justice and inclusiveness.

However, these broader issues were not the core focus of the research; the main objective of this research was to determine whether teaching method and curriculum content could influence the conversion of science, technology and innovation studies into effective policy. It is stressed that this article is not attempting to cover the broader imperative for transformation and change, particularly to address issues of racism and exclusivity. The argument of this article is that educators in science and technology policy studies within developing countries must pay careful attention to content and pedagogy if graduates of these programmes are to feel fully empowered as policy practitioners consequent to their training.

In this respect, the scope of the article is ambitious and extends beyond the existing evidence. The proposition that low rates of innovation are the consequence of the legacy of inappropriate curriculum content and teaching methods, and that this weakness can be improved through addressing issues of epistemic justice and situatedness, is still evolving. More research is needed to understand how curriculum transformation could begin to address the objectives of inclusive innovation and development, and whether the constraints to such development are indeed the consequence of two important factors, namely the limited situatedness of knowledge production and dissemination, and the inducement of feelings of alienation for students of science and technology policy. Social constructs are inherently qualitative and context dependent. In order to adequately explore the meaning of the constructs such as epistemic justice, decoloniality and situatedness within the South African student context, qualitative investigation will be required. The constructs should be operationalized more comprehensively for future studies to enhance the alignment between the instruments and the constructs.

Conclusion

The central claim of this article is that changes to the way in which science, technology and innovation policy are taught, and particularly the introduction into the 'classroom' of techniques related to epistemic justice and situatedness, could improve learning outcomes. In an initial exploratory study, a number of teaching interventions were introduced to a module on engineering economics. Student perceptions of the interventions were assessed through an online questionnaire. The survey was sent to all the students who were registered for the module.

Recommendations which have emerged from the study are summarised as follows:

- **Multiple methods should be considered:** developing the capabilities of personhood self-formation and epistemic justice may require combinations of changes to teaching and learning. This means all aspects of the curriculum need to be reconsidered and reconceptualised for students who come from different ontologies than curriculum designers.
- **Assessment for blended learning should be designed for fairness and accessibility:** Assessment in blended-learning courses may require more flexibility and innovation from the course designer (Purvis et al., 2011). Assessing in a blended-learning environment should reflect the dynamic nature of learning through technology, and could include interactive simulation, collaborative learning, peer e-assessment and flipped classrooms (El-Mowafy et al., 2013). Moreover, assessment practices in blended-learning courses should be systematic and dynamic, in such a way that elements from the course are well integrated and fairly accessible and understandable for all students (Serrano et al., 2019).
- **The teacher should act as a catalyst for epistemic justice:** The educator can play an important role in implementing curriculum change and creating learning environments which are conducive to students from all types of backgrounds.
- **Qualitative study into the personal meaning for students of the concept of epistemic justice is required:** The constructs of personhood self-formation, decoloniality and social freedom still

need to be understood from the perspective of the student. The manner in which students co-constructs their own personhood, ontology, and agency is profoundly personal and requires evidence from lived-experiences. The creation of personal meaning within a local context is an area that requires substantial more research.

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