Assessment and epistemic (in)justice: how assessment produces knowledge and knowers

Juuso Henrik Nieminen & Juulia Lahdenperä

Published online: 01 Sep 2021.

Submit your article to this journal ↗

View related articles ↗

View Crossmark data ↗

Routledge
Taylor & Francis Group

Assessment and epistemic (in)justice: how assessment produces knowledge and knowers

Juuso Henrik Nieminen 🔟 [a] and Juulia Lahdenperä 🔟 [b,c]

[a]School of Educational Sciences and Psychology, University of Eastern Finland, Joensuu, Finland; [b]Department of Mathematics and Statistics, University of Helsinki, Helsinki, Finland; [c]HAMK Edu, Häme University of Applied Science, Hämeenlinna, Finland

ABSTRACT

Assessment is often used to promote learning, but the mechanisms of how assessment relates to epistemology – knowledge and knowing – have been scarcely studied and theorised. In this study, we examine students' epistemic resources in relation assessment in the context of university mathematics education. We draw on the theoretical framework of epistemic injustice in order to understand how assessment produces knowledge and knowers. Using reflexive thematic analysis, we analyse 77 students' essays about their experiences and ideals of assessment practices. We discuss how the students contributed to co-constructing the dominant status of exams in mathematics - exams were deemed fit to assess mathematical knowledge. At the same time, experiences of alternative assessment practices enabled students to re-define what constitutes valid knowledge and how such knowledge can be demonstrated and assessed. We conclude by noting that developing student-centred assessment practices not only fosters students' learning but also promotes their epistemic resources.

Introduction

Higher education research has promoted the importance of aligning pedagogy with the purposes of education and highlighted the crucial role of assessment in the process. For example, the notion of sustainable assessment has emphasised assessment as being the key factor in preparing students for the future (Boud and Soler 2016). However, assessment often runs contrary to such goals through traditional assessment and grading practices (Boud et al. 2018; Nieminen 2020a). Indeed, Boud and Falchikov (2006) claimed that assessment needs to be realigned with the overall purposes of higher education by seeing students as active agents in their own learning: 'Graduates in the workforce will not in general be taking examinations or writing academic essays'. (403) Similar ideas have been discussed through 'authentic assessment' that widens the idea of 'knowledge' through collaborative 'real-life' assessment practices (Ashford-Rowe, Herrington, and

Brown [2014]). Yet, notions of knowledge and knowing have received less attention in assessment research. This is possibly due to the largely psychological and apolitical roots of the field (see e.g. Boud et al. [2018]; Nieminen [2020a]). Beyond assessment research, the importance of supporting knowledge co-construction processes through educational practices has been recognised (Carnell [2007]; McLean, Abbas, and Ashwin [2018]). For example, Walker ([2020]) asserted that communal knowledge promotion was the main purpose of higher education, stating that students should be involved in its project of knowledge construction through creating opportunities for 'interpretive contributions to the pool of knowledge, understanding, and practical deliberation' (270). The way in which *assessment* could promote such goals, especially in the STEM context, in which the idea of 'knowledge' has traditionally drawn on positivist epistemologies, is precisely within the scope of this study.

We address assessment from the perspective of epistemology as the philosophy of knowledge – what counts as knowledge and how knowledge is produced (Brough [2013]). There is a two-fold connection between assessment and epistemology: assessment both reflects how disciplines can be known, and emphasises certain kinds of knowledge and ways of knowing (Gergen and Dixon-Román [2014]). As Knight, Shum, and Littleton ([2014], 27) put it: 'The ways that we assess, the sorts of tasks we set, and the kinds of learning we believe to take place (and aim for) are bound up in our notions of epistemology'. For example, mathematical knowledge might be assessed through tests and exams because mathematical knowledge is seen as 'objective' and thus measurable compared to other disciplines such as the arts. At the same time, tests and exams affect students' understanding of what mathematical knowledge is and how such knowledge can be demonstrated and validated (Nieminen [2020b]). In the present study, we particularly focus on the students' perspectives on epistemology as their perception of assessment significantly affects their assessment behaviour (Struyven, Dochy, and Janssens [2005]). While these perceptions have been widely studied, the interplay between students' epistemological beliefs and assessment remains an understudied field (Iannone and Simpson [2019]). Related to epistemic belifs, an awareness of purposes and processes of assessment has been described as a key factor for students' assessment literacy (Smith et al. [2013]). However, empirical studies in this field are scarce. As it has been shown that students are co-creators rather than recipients of the epistemologies of assessment (Nieminen [2020a]; Raaper [2019]), student perspective represents an important research gap.

In this study, we bring together the research fields of assessment and epistemology, as research in the intersection of these fields has thus far been scarce. We examine the processes of how educational assessment produces knowledge and knowers in higher education. We achieve this by analysing 77 short essays by students on teaching and assessment practices using reflexive thematic analysis to highlight the students' epistemic resources in relation to assessment. As assessment-related epistemologies are about knowledge and knowing, they are strongly associated with disciplinary knowledge as an epistemic activity. Thus, our task, by definition, is context and discipline specific (cf. Knight, Shum, and Littleton [2014]; Iannone and Simpson [2019]). This study is situated in the context of university mathematics, which has been characterised as a traditional, exam-driven culture (Nieminen [2020a], [2020b]) in which the 'right or wrong' kind of understanding of knowledge might result in epistemic injustice (Solomon and Croft [2016]; Tanswell and Rittberg [2020]). However, in our departmental context, radical

changes have been implemented in teaching (Rämö et al. 2019) and assessment practices (Nieminen, Asikainen, and Rämö 2019; Häsä, Rämö, and Nieminen 2021), offering a fruitful context in which to examine how assessment practices both promote and hinder the students' capacity to know and demonstrate knowledge. Taking this critical and sociocultural approach to epistemology, we highlight epistemic justice and injustice in assessment. In line with Walker (2020), we identify epistemic injustice in which students are not recognised as knowers because barriers are set to their ways of knowing and displaying knowledge; in which assessment would 'undermine universities as developmental spaces of becoming and critical being' (263).

Theoretical framework

We conceptualise the students' perspective of assessment through the notion of *epistemic injustice*, drawing on philosophical literature on epistemology (Fricker 2007) in order to understand how assessment produces knowledge and knowers. Before introducing this specific framework, we briefly introduce how it supplements previous assessment research around similar topics.

First, many higher education studies have drawn on the concept of *epistemic beliefs* in terms of both teaching (see Lucas and Tan 2013) and assessment practices (O'Donovan 2017; Iannone and Simpson 2019). In tandem with this literature are the psychological research traditions of studying students' conceptions (e.g. Flores et al. 2020) and perceptions (Struyven, Dochy, and Janssens 2005) of assessment in higher education. We depart from these important contributions by taking a sociocultural perspective. More specifically, we look beyond the techno-scientific understanding of epistemic beliefs as a construct that can be measured, compared and controlled (cf. Hofer 2001; Iannone and Simpson 2019). Penuel and Watkins (2019) argue that such a sociocultural perspective might be necessary to understand assessment as epistemic practices that are far from neutral in their contribution to justice and injustice (see also Gergen and Dixon-Román 2014). Thus, we address epistemology using a collective rather than an individual approach.

Another branch of assessment research we wish to highlight has focused on *epistemological power* (Tan 2004; Patton 2012; Taras 2015; Nieminen 2020a, 2020b). This research has developed our understanding of how assessment constructs power imbalances, as epistemological power does not reside in individuals but is manifested through institutional epistemologies of what is regarded as knowledge and how knowledge is produced (Tan 2004; Hanafin et al. 2007). We contribute to this literature by further examining the mechanisms of knowledge construction in relation to assessment. We also strengthen these previous contributions theoretically by drawing on philosophical research literature on epistemology.

Epistemic resources and injustice

The concept of epistemic resources refers to shared and collective beliefs concerning assessment (Dotson 2014; Shotwell 2017). Such resources do not regulate the individual student's ways of knowing, but the epistemic subject of 'a student' (Brough 2013). According to Dotson (2014), epistemic resources within a given community of knowers allow people to 'participate in knowledge production and, if required, the

revision of those same resources' (115). According to Fricker (2015), contributing to the production of epistemic resources and materials in a given context is fundamental to human well-being; Fricker (ibid.) argues that epistemic contribution should be acknowledged as a key human capability.

Shotwell (2017) notes that 'dominant practices of epistemology' could delimit the students' range of epistemic resources: 'The collective epistemic resources on which we depend to make sense of and engage the world may be both impoverished and harmed by systemic oppression' (86). This is why we utilise the concept of epistemic injustice, doing wrong to someone 'specifically in their capacity as a knower' (Fricker 2007, 1). Here, 'injustice' refers not to the wrongdoing of one agent towards another, as the colloquial understanding of the word might imply, but to the structural limitations of the epistemic resources of subjects. In particular, we draw on *hermeneutical injustice* as outlined by Fricker (2007). Hermeneutical injustice manifests as the way in which someone's lack of epistemic resources – their capacities as a knower – affects their sense-making of reality.

In the context of mathematics, it has been noted that students are aware of an exam-driven culture that limits their understanding of what kind of knowledge is assessable, and how such knowledge can be displayed in assessment (Nieminen 2020a, 2020b). A hermeneutical form of epistemic injustice indeed restricts the capacity of students (and teachers) as epistemic subjects (Fricker 2007). Tanswell and Rittberg (2020) discussed epistemic injustice in mathematics education: framing mathematical practices as 'acontextual' and 'universal' is an epistemic practice itself, often deeming other forms of knowledge invalid (Solomon and Croft 2016). We apply this idea to assessment by reframing assessment practices as epistemic practices. Assessment contributes to knowledge construction processes rather than being external to them. Shotwell (2017) stated that in educational institutions, epistemic practices often neglect forms of knowledge deemed to be non-academic, such as 'know-how knowledge' and 'embodied knowledge'. Valuing academic knowledge in assessment could result in epistemic injustice, as certain kinds of student knowledge and ways of demonstrating knowledge are deemed invalid (Hanafin et al. 2007). For example, such epistemic injustice has been shown to cause inequity while assessing students with disabilities (Nieminen 2020b).

Even though it has been demonstrated that epistemic injustice restricts students' ways of knowing, it is important to note that through this framework, students are understood as epistemic agents rather than as non-agentic recipients of injustice (Dotson 2014; Doan 2018). Raaper (2019) noted that students act as active negotiators of power structures through their strategic assessment behaviour. Nieminen (2020a) showed that through assessment practices that disrupt the dominant institutional epistemologies of mathematics assessment, it is possible to raise students' awareness of the prevailing epistemologies. This allows assessment practices to promote reflexive thinking, and indeed, epistemic justice.

So how can epistemic injustice be challenged and resisted? Fricker (2007) argued that this can be achieved by raising the *epistemic consciousness* of the lesser knowers. In the exam-driven context of mathematics, this could mean offering students reflective tasks that promote critical examination of the disciplinary assessment culture (Nieminen 2020a). Dotson (2014) elaborated on raising awareness within disciplinary cultures in which epistemological power maintains the resilience of the prevailing epistemic justice by noting that such resilience can be challenged through small sparks of

consciousness that might finally lead to substantial changes in the dominant epistemologies (see also Hanafin et al. 2007). However, when epistemic injustice is present, raising awareness might not always be sufficient to disrupting epistemic injustice. Sometimes it is 'necessary to engage in struggles for epistemic recognition and self-determination in the face of persistent harms' (Doan 2018, 10). Instant changes in modes of assessment would highlight the ethical aspects of assessment in how teacher-led assessment and grading practices might impose identities on others through ways of knowing that are epistemologically more valid. In certain contexts, there could be a need to reframe students in assessment as epistemic agents if the purpose of higher education was to be fulfilled (Raaper 2019; Nieminen 2020a). However, even radical and instant changes should also contribute to a process of radical restructuring of the dominant institutional epistemologies (Doan 2018; Dotson 2014).

Research objective

Our overall research objective was to understand processes of knowledge production in relation to assessment in higher education. To supplement previous studies on assessment and epistemic beliefs (e.g. O'Donovan 2017; Iannone and Simpson 2019), we reached beyond the individualised understanding of 'beliefs'. Drawing on the concept of epistemological resources (Dotson 2014), we ask: What kind of epistemological resources do students possess regarding assessment in the exam-driven context of mathematics? We answer this question by drawing on an institution-wide analysis of students' short essays.

In the discussion section, we review our findings using the theoretical concepts of epistemological power and injustice; we reflected on the findings of the first research question in order to form a synthesis. Overall, our study represents a strongly theory-orientated approach to educational assessment, a field characterised by psychological and cognitive paradigms. Thus, while our study is empirical in nature and includes a rigorous data analysis, we position this paper as a discussion paper; we aim to understand epistemic (in)justice in educational assessment by offering a novel way of approaching assessment through educational theory.

Methods

Context

The study was conducted in the mathematics department of a research-intensive university in Finland. In Finland, university teachers enjoy a considerably high level of academic freedom to choose their teaching and assessment practices; grades have minimal effect on their students' future lives and exams can usually be taken repeatedly.

Traditionally, a university mathematics course in the department comprises six weeks of lectures (approximately five hours a week) and small group sessions (approximately two hours a week) (Lahdenperä and Nieminen 2020). The students are set weekly tasks and the small group sessions often involve going over the tasks the students solved prior to the session. The tasks generally have only one correct solution, even though multiple pathways could be used to reach it. The proposed solutions to the tasks are published after they have been addressed in the small group sessions. In this

traditional context, assessment centres around closed-book exams. The tasks usually contribute to the final grade and are therefore summative in nature: the more tasks a student completes, the more bonus points they receive (e.g. by completing 90% of the course tasks, a student can gain 20% of the course exam points). The weekly tasks form the backbone of mathematics teaching and learning. Also, alternative assessment practices (e.g. self- and peer assessment practices) are often directly related to these tasks.

While university mathematics is often introduced in a teacher and exam-driven context (Iannone and Simpson 2019; Nieminen 2020a, 2020b), teachers in the mathematics department in our study are pioneers in developing the department's teaching practices. Over the past decade, the department has undergone a major cultural shift towards creating a collaborative community of learners. This is evident in the application of the Extreme Apprenticeship method, whereby the department hires mathematics students to work as tutors on the teaching teams of various courses (Rämö et al. 2019). Accompanying the changes in teaching, assessment practices have also become more diverse: many courses now use digital self- and peer-assessment practices (DIGest; Koskenoja et al. 2018). Some courses also draw on the summative self-assessment model (DISA; Nieminen, Asikainen, and Rämö 2019; Häsä, Rämö, and Nieminen 2021), which enables students to choose their own course grades after participating in a formative self-assessment process. As both teaching and assessment practices have been developed, the mathematics department serves as an interesting context for the present study. However, it should be noted that teacher-led assessment was still dominating students' experiences of assessment in our dataset. As one student in the study put it: 'I have never taken part in an oral assessment, nor have I completed a mathematics course with a project or essay'.

Participants and data collection

Open-ended survey data were collected in order to investigate the students' epistemic resources on an institutional level. The data comprise 77 Finnish mathematics students in one department (Lahdenperä and Nieminen 2020). The students were invited to participate in the questionnaire via an email they received from the email lists of the mathematics department and the corresponding student organisation. The participants comprised 53.2% women and represented students from various study years at the university (40.3% 1–3 years; 27.3% 4–5 years; 32.5% > 5 years).

The questionnaire comprised a short semi-structured short essay (Cohen, Manion, and Morrison 2018) on students' experiences and ideals concerning teaching and assessment practices. The semi-structured short essay allowed us to capture the students' rich and personal experiences and ideals, and also guide the students using prompts (ibid., 321). The open-ended questions were about the university's mathematics learning environment. The students were instructed to reflect on course practices that concern, for example, lectures, small group sessions, weekly tasks, guidance, assessment, etc. The students were asked to reflect on the practices of their favourite course, their least favourite course, and the ideal course that would perfectly reflect their needs. Finally, one open-ended question specifically concerned assessment practices that would support the student's learning in the most optimal way. Using these questions, we aimed to capture the students' epistemic resources regarding assessment through both personal experiences and ideal 'assessment utopias'.

Two focus group discussions were organised with mathematics students in order to discuss the questionnaire. The aim of the discussions was to ensure that the questionnaire had been fully understood by the students (see Lahdenperä and Nieminen [2020] for further details), and the questionnaire was revised according to the students' feedback.

Data analysis

We analysed the dataset using reflexive thematic analysis (Braun and Clarke 2020). This method offered us a way of making sense of the dataset through a meaning-making process that was compatible with the sociocultural epistemological stance of the study; the analysis did not aim to assess the level of individual students' epistemic resources, but to examine the epistemic resources of the student subject. The method enabled us to reflexively construct themes in a way that took into account both the theoretical background of the study and our own disciplinary knowledge of the context. We drew on the latest version of the reflexive thematic analysis framework of Braun and Clarke (ibid.), comprising six phases: (1) data familiarisation and writing familiarisation notes; (2) systematic data coding; (3) generating initial themes from the coded and collated data; (4) developing and reviewing the themes; (5) refining, defining and naming the themes; and (6) writing the report which, in our case, also included the discussion section.

First, we familiarised ourselves with the data by carefully reading it multiple times while keeping a log and sharing our thoughts through regular meetings. During this phase, we also reduced the dataset by only focusing on the parts of the essays that concerned assessment (while including all the responses to the questions that were specifically about assessment). Next, we conducted in vivo coding by using the students' own words and statements as codes (Saldaña 2016) in order to understand their perspective of assessment as much as possible. This was particularly important as we were processing essay data. After this phase, we constructed themes, 'patterns of shared meaning, united by a central concept or idea' (Braun and Clarke 2020, 14), based on the coded units. During this process, we addressed each student's response as a whole rather than addressing all the units as one pool of responses. Based on the codes, we did not identify themes but *constructed* them. As a method, reflexive thematic analysis 'emphasises the importance of the researcher's subjectivity as an analytic resource, and their reflexive engagement with theory, data and interpretation' (Braun and Clarke 2020, 3). In order to demonstrate the sociocultural nature of epistemic resources, the theme formation process included our own disciplinary knowledge of the context. We did not conceal our contextual knowledge but constructed the themes based on this knowledge. This method reflects our understanding of context as a key agent in the epistemologies of assessment (Knight, Shum, and Littleton 2014).

As the reflexive thematic analysis drew on sociocultural epistemology, we do not intend to discuss the 'validity' of the process but instead draw on Lincoln and Guba's (1985) concepts of legitimacy and consistency. It was crucial to discuss the findings and the process through active and critical reflection throughout the analysis. Also, we have reflected on all 19 criteria listed by Braun and Clarke (2020) for well-developed and justified reflexive thematic analysis. While we do not have the space to fully elaborate on all the criteria, most of them are discussed in the methods and findings sections.

Finally, the themes we constructed with the dataset were further discussed by re-reading and interpreting them through the framework of epistemological power and epistemic injustice. This final part of the analytical process made an important contribution to discussing the consistency of our findings (see Lincoln and Guba 1985) as we invite the reader to critically reflect on our interpretation. Given that the discussion of the findings is a part of the analytical process, we would remind the reader that the reflexive thematic analysis does not aim to 'identify the most fitting set of themes'. Rather, the themes we have constructed are highly contextualised and constructed through our subjectivity as researchers.

Findings

We start by introducing the students' perspective of the epistemic nature of mathematics, followed by an investigation into the mechanisms in which assessment practices have both hindered and promoted the students' epistemic resources. A few key issues should be noted. First, we have not analysed individual student's epistemic resources, but the collective resources of the student subject (Dotson 2014). The themes do not 'cover' the dataset but form a theoretical synthesis (Braun and Clarke 2020). These themes do not form a coherent system but occasionally contradict each other; we offer examples of how individual student's essays contained contradictory elements. Throughout the section, we refer to students by their IDs and have added emphasis to the citations by writing keywords in bold.

About the epistemic nature of mathematics

How mathematics is or should be assessed was strongly associated with the epistemic nature of the discipline itself. Students regarded mathematics as being a subject that relied on right and wrong answers, thus making it 'easy to measure through exams' (ID49). As mathematics is based on tasks that could involve multiple strategies but only one correct answer, exams were regarded as an appropriate means of measuring knowledge – a theme that was strongly present throughout the dataset.

It was not only the nature of mathematics that framed the students' epistemic resources, but how they described the way in which mathematics is practiced. Overall, the students reported that assessment should not simply promote the memorisation of mathematical content by rote. Some of the students regarded exams as a suitable way of assessing mathematical knowledge but wanted open book exams with materials because 'complex formulae should not be needed in order to memorise' (ID52) and 'memorising by heart is pointless' (ID49).

Overall, the students reported that assessment practices should take into account the students' *ongoing work* and development. A current theme was that assessments – and exams in particular – *force* students to study. The students reported that exams 'encourage me to study better' (ID13) and that while preparing for the test you '**must** go over the course content more carefully than you would if the grade were only awarded based on the weekly tasks' (ID24). ID36 stated that preparing for exams is the most effective way for them to learn, yet still wanted continuous assessment because 'incentives such as bonus points motivate'. Some students stated that a lack of assessment structure resulted

in a lack of motivation: 'As no small group sessions had been scheduled, although guidance was always available, there was no motivation to make an effort' (ID31).

Exams as the dominant epistemic practice

Exams as an assessment practice stood out, as exams were described as the default way in which mathematics is and should be assessed. Overall, the students referred to exams as 'traditional' and default assessment practices. It was extremely rare for students to describe their ideal assessment utopia *without* an exam.

What sustained the dominance of exams was their ability to produce *objective* information about student knowledge. Exams were commonly described as 'testing' (ID19) and 'measuring' (ID6) knowledge. For example, ID13 stated that 'I like exams as they **truly** show me my abilities'. ID30 stated that exams are 'a good way of determining whether the course content has stuck in your mind'. The degree of objectivity of the knowledge produced through exams was often compared with other assessment practices, such as self-assessment. The objectivity of exams was emphasised because, without validation, a student's mathematical knowledge might not be *real*. ID19 wanted a less exam-orientated mathematics assessment culture and more diverse feedback practices, but still hoped for 'short exams that would measure your knowledge so you didn't just get the right answers randomly'. ID62 strongly advocated the importance of collaborative problem solving and group work in how mathematics should be learnt *and* wanted assessments to include objective and individual exams that would 'measure your skills directly, without receiving praise'. Also, many of the students stated that 'exams are an appropriate and equal way of assessing large numbers of students' (ID58), demonstrating their understanding of institutional epistemologies.

A unique way of learning mathematical knowledge was *revising for exams*. Students described revising as being a substantial part of learning mathematics. Revising the course material for the exam was referred to as a process of 'learning content that had previously been unclear' (ID72). ID24 stated that revising for exams 'makes you study more diligently'. It was also stated that exam revision 'aggregated the learned content' (ID55) and 'clarified the bigger picture regarding course content' (ID65). It should be noted that the students did not want review materials; they wanted exams. The aim of revising for exams was to 'help the student succeed in their **exams**' (ID30) – not in learning.

The students rarely described a mathematical learning process that did not include an exam. ID21 described how the students created a voluntary study group in which to socialise and learn mathematics together; one of the students was responsible for producing exams and grading them for the others. Tensions were noted when the students criticised various assessment practices for their narrow focus on mathematical knowledge, but still promoted the use of exams. ID31 described their ideal learning environment in which they could 'focus on complex tasks in our own time – – focus on learning rather than on passing the exam'. However, they still wanted open book exams because then they would not be expected 'to learn by heart but would still be expected to learn **properly**'. Similarly, ID41 described their anxiety about exams, stating that what they needed in assessment was 'encouragement and support – an empathetic approach is important', also noting that 'it would be great if you were able to pass a course simply by working

hard during the course'. Yet their ideal learning environment still involved exams that validated the differences between learners with various skills.

> I prefer learning by reflecting with others rather than a teacher transferring knowledge to me and then vomiting the knowledge onto the paper during the exam. (ID2)

<center>*   *   *</center>

> I think it's good to still have an exam about course topics, because exams provide an overview of what students know. (ID2)

Students as lesser knowers than teachers

The students generally described their teachers as being more *valid* knowers than themselves. Teacher-led assessment and feedback practices were largely described as 'reliable' (ID28) and 'valid' (ID60). As ID11 put it, assessment needs to be conducted by 'someone more competent [than me]', noting that 'a peer assessor might not be capable of reviewing a mathematical solution that differed significantly from the model answers, or notice details that are tied to their broader context'. As teachers and student tutors were described as being more valid knowers of mathematics, their ideal role was described as being a 'guide who steers us in the **right** direction' (ID48).

While almost all the students had something to say about how mathematics *should* be taught, this was not the case with assessment. For example, ID3 suggested that they did not have 'enough experience of assessment', while others ignored the prompts and stated that 'I don't know how to answer' (ID9) and 'I haven't been able to find an answer to this question' (ID21). We interpreted these replies as representing a culture in which students are not used to reflecting on assessment.

Alternative assessment as epistemically invalid

Overall, the students deemed alternative assessment practices to be epistemically *invalid*. Knowledge produced through such practices was not as valid as knowledge produced through teachers and exams. Peer assessment was largely considered to be epistemically invalid since 'other students lack the ability to assess others' solutions' (ID19). ID14 stated that 'peer feedback does not work in situations when you **really** need information about your mistakes, what you have misunderstood'. Similarly, ID32 stated that when it comes to feedback, what mostly supported their learning process was 'feedback directly from the lecturer/professional', as 'it's only then that I know the feedback is valid'.

Many students saw self- and peer assessment as useful but epistemologically invalid learning methods. For example, ID20 stated that peer and self-assessment would be part of their ideal learning environment 'but in a way in which someone would validate the results'. For the same reason, many students stated that peer and self-assessment should not count towards grades. One student questioned the participation of students while discussing the learning objectives of a course:

> During a lecture, we were asked what we wanted to learn or cover. How would I know what I was supposed to learn? (ID42)

Increased epistemic resources through critical consciousness

Even though exams and teacher-driven practices generally played a key role in our dataset, there were many references to increased epistemic resources. Students referred to the relational, social and subjective aspects of assessment. They criticised the stressful element of the exam-driven assessment culture:

> A written exam at the end of a course that determines the entire course grade creates a distressing pressure and then the learning focus is on passing the exam, not on learning. (ID26)

> Assessment should aim **to strengthen the student's perception of themselves as a mathematics student** and provide opportunities to improve in topics that they perceive as difficult. (ID51)

The students critically reflected on the purpose of assessment. Overall, the students reported that assessment should be redesigned to better support learning. ID14 stated that it was important that 'the lecturer does not merely transfer information', seeing the ideal purpose of assessment as being to 'prevent bulimic learning':

> Continuous studying that is free of stress and strives to understand will guarantee the best learning outcomes for me. The stress is usually the result of not understanding, and it increases when you become aware that you will have to vomit everything onto the exam paper. (ID14)

Many students criticised assessment practices that did not reflect how mathematics is used in real life. ID61 thought that assessment should regard mistakes as learning opportunities: 'It's okay to make mistakes, but you must be given the opportunity to rectify them'. Many students called for a form of assessment that would promote mathematical knowledge needed in working life because 'the most important thing is to know how to use what you have been taught' (ID39). ID74 strongly promoted the idea of dialogue in assessment: 'I'm not a calculator. Understanding, applying and developing theory is more interesting to me than following a formula'. Another student commented:

> A dissertation is a good way of learning, because solving problems and writing about them is **what mathematicians actually do**. It's not a mathematician's job to sit in a closed exam hall giving answers based on facts and solving procedures learned by heart. So it makes no sense that the education of future mathematicians should prepare you for this kind of activity. (ID53)

Diverse assessment practices, diverse ways of knowing

A critical awareness of the prevailing epistemologies of assessment were evident in the preferences to be assessed using diverse practices in order to demonstrate multiple ways of knowing. The more diverse set of assessment practices of which the students *were aware* was coded as increased epistemic resources. Many students directly criticised exams: 'With a set of ongoing tasks you probably learn better compared to one final exam' (ID5). ID8 stated: 'We need to move away from the exam-driven culture in mathematics education'.

What, then, could complement exams? The students described, for example, self-reflective lecture diaries (ID33) and project-based assessment (ID8) as ways of expanding mathematics assessment. Two other students stated:

> Self-assessment feels like a great tool. I would like to see a learning objective matrix on every course. (ID11)

> Peer assessments are a great idea, as well as the bonus points you earn. In the final assessment you could emphasise the tasks a bit more than the exam. The exam could also take place online. (ID55)

Some students described a learning environment with no exam as being their ideal kind of course, challenging the dominant epistemic status of exams. Many students preferred mathematical tasks, large projects and self-assessment to exams. The students stated that these practices were more aligned with the skills they needed in their studies and their future life as mathematicians. One student described how a course with no exam might look:

> The course wouldn't have any exams. The grade would be determined through weekly mathematical tasks and other course work, which would provide the opportunity to receive help, for example, in the form of small group teaching. (ID39).

Self- and peer assessment can increase epistemic awareness

The students reported that self-assessment helped them see their own development rather than only depending on the views of others. ID23 stated: 'I think self-evaluation really supports my learning. If I have a basis upon which to evaluate my performance then that's all I need'. ID89 stated how important it is to compare knowledge produced through continuous self-assessment with one of the teachers. It is important to note that the accuracy of self-assessment is not synonymous with self-assessment as an epistemologically valid practice. As many students stated, learning to self-assess more accurately, or in more analytical terms, supported their learning process. However, it was only when such an objective process was described as a *valid* way of knowing, that such notions were coded under this theme. For example, ID17 was not included under this theme as they outlined the useful aspects of learning how to self-assess, while still questioning its 'objectivity':

> I don't know how **objective** self-assessment works but I like it because it helped me identify the areas in which I need to spend more time on learning. Self-assessment helps me identify my skills, or lack thereof. (ID17)

Finally, the students associated peer assessment with being able to identify other ways of knowing and doing.

> Self- and peer assessment have supported me. They require the students to review the proposed model solutions and when you are conducting a peer assessment, you can easily see other students' thoughts and ways of solving the same tasks. Self- and peer assessment have clarified and helped me understand the tasks better. (ID25)

This was associated with multiple benefits, such as creating an awareness of how other students also make mistakes. (ID44)

Discussion: epistemic injustice in action

Overall, our study has highlighted the power of assessment in higher education; how assessment not only drives learning and studying, but also ways of knowing (Gergen and Dixon-Román 2014; Knight, Shum, and Littleton 2014). Through a theoretically-

orientated approach to epistemology, we have empirically discussed the ways in which assessment both promotes and restricts the students' epistemic resources, and consequently requires ethical consideration. In this final section, we discuss our findings through the lens of epistemic injustice.

While unilateral assessment cultures (Boud and Falchikov 2006; Boud and Soler 2016; Nieminen 2020a) and the injustice of universal 'right and wrong' epistemologies (Solomon and Croft 2016; Tanswell and Rittberg 2020; Nieminen 2020b) have been previously criticised, we have examined the ways in which assessment restricts the students' epistemic resources in exam-driven disciplines: The students' epistemic resources were restricted by teacher-driven assessment practices. This is not surprising in relation to previous studies, which have described exams as being an institutional epistemology (Hanafin et al. 2007) in mathematics (Nieminen 2020a, 2020b). As noted in previous studies on self-assessment (Tan 2004; Taras 2015) and peer assessment (Patton 2012), alternative assessments might not shift the 'validity' of knowledge from teachers and tutors to students; the students' responses further confirmed the key role of teachers and exams as the highest validators of knowledge. The students were not simply recipients of epistemic injustice but further contributed to it (cf. Raaper 2019; Nieminen 2020a, 2020b). This restricts the students' capacity as knowers (Fricker 2007) and, by definition, constitutes epistemic injustice in action. These findings remind us of the challenges of implementing learner-centred formative assessment practices in the STEM contexts, and in other contexts that draw on a positivist understanding of knowledge.

In students' essays, the forms of knowing mathematics (Shotwell 2017) in assessment were limited and nearly always rendered through test situations. Objective and teacher-driven assessment were associated with the universal and acontextual epistemic nature of mathematics (Solomon and Croft 2016) which, in turn, has been associated with epistemic injustice (Tanswell and Rittberg 2020). These findings highlight the epistemic role of tests and exams in learning mathematics: they are indeed epistemic practices that determine how mathematics can be known and practiced. While the epistemic nature of mathematics itself undoubtedly affected the students' epistemic resources, assessment played a special role in how it *individualised* knowers; assessment rendered knowledge as something measurable and controllable that individual students possessed. This could create further injustice as other forms of knowledge (e.g. communal knowledge, embodied knowledge) are deemed invalid in assessment (Shotwell 2017; Nieminen 2020b). Such injustice is contrary to the purpose of higher education as the producer of future knowledge workers (Boud and Falchikov 2006; Boud and Soler 2016). Importantly, not only exams but also formative assessment practices (e.g. self- and peer assessment) were part of individualising the students; even while the students' epistemic resources were promoted through such practices, examples of radically different forms of knowing (e.g. communal forms) were absent in the data.

We do not intend to create unhelpful assessment myths, such as presenting exams as a form of assessment that is 'evil' or 'bad'. Instead, we challenge the STEM disciplines and other fields of higher education that draw on positivist epistemologies in order to critically reflect on the role of assessment in the processes of producing knowledge and knowers. In undergraduate mathematics, for example, it is most often teachers who possess more knowledge compared to students, whose role is to learn the predetermined mathematical methods and procedures in a cumulative manner. However, there is a

danger of restricting students' epistemic resources if they are rarely offered opportunities to demonstrate their knowledge through their personal epistemologies. Bearman and Luckin (2020) called for AI-proof assessment in higher education and the digital world to promote skills and capabilities that are inherently *human*. They discuss, for example, meta knowledge and personal epistemologies as being the backbone of a form of assessment that would take into account students' professional identities, previous experiences and critical thinking. Thus, teacher-driven practices should not be contested in terms of whether they should be used, but in terms of how they could prepare students to become future knowers and doers in their disciplines.

In our context, in which teaching and assessment practices have been developed (Nieminen, Asikainen, and Rämö 2019; Rämö et al. 2019; Häsä, Rämö, and Nieminen 2021), the students also critically examined the structures of assessment. As Knight, Shum, and Littleton (2014) suggested, student-centred assessment practices offer the opportunity to both guide and challenge the students' epistemic beliefs. Our findings suggest that developing teaching and assessment practices not only supports the quality of learning, but produces epistemic resources. Our findings do not merely indicate that student-centred assessment practices should be prioritised over 'teacher-driven' practices. Instead, we have shown how diverse and student-centred practices, both summative and formative practices, can enhance students' epistemic resources in order to critically contest the mere dichotomy of student/teacher-centeredness. Even dominant institutional epistemologies are socially constructed and can therefore be redefined (Doan 2018; Dotson 2014; Hanafin et al. 2007). We note that while developing assessment, students should be regarded as epistemic agents. In fact, the extreme apprenticeship method was originally a student initiative (Rämö et al. 2019). We call for authentic – and student-co-produced – assessment tasks (Ashford-Rowe, Herrington, and Brown 2014) to disrupt inauthentic assessment practices that may not only be detrimental to learning but also to *knowing*. Furthermore, we call for diverse summative and formative assessment practices for positivistic fields of knowledge, such as the STEM field, to enable students to demonstrate their knowledge in deeply personal ways as future professionals (Bearman and Luckin 2020). This could allow assessment to challenge epistemic injustice by enabling traditionally discriminated students, such as women (Solomon and Croft 2016), or students with disabilities (Nieminen 2020b), to understand themselves in multifaceted ways as thinkers, doers and knowers in their fields. Examining epistemology from a sociocultural perspective might enable us to further understand the disciplinary nuances of assessment literacies (Smith et al. 2013) because *being able to self-assess accurately* cannot be equated with *producing valid knowledge through self-assessment*. Indeed, even an accurate self-assessment can be deemed invalid by students (Nieminen 2020a). Importantly, this notion also holds great value for psychologically-orientated assessment research.

Several limitations should be discussed. While allowing us to conduct an institution-wide analysis, our short essay dataset limited our interpretations. For example, we were unable to examine the nuances of the intertwined processes of assessment, grading and feedback, as well as knowing, doing, memorising and practicing mathematics. Similarly, the complexities between the various ways of knowing and demonstrating one's knowledge of assessment should be further examined using richer datasets. Also, we critically reflect on our reflexive analysis method. It is possible that the sociocultural perspective

may have 'biased' our analysis; yet our analysis has certainly not aimed at producing 'valid knowledge' in a positivistic manner. This approach enabled us to analyse collective epistemic resources, thereby responding to Iannone and Simpson's (2019) call to understand context-specific epistemologies (see also Knight, Shum, and Littleton 2014). From a sociocultural perspective, we have highlighted the systemic issues of assessment, which should be addressed through systemic solutions (Boud and Soler 2016; Boud et al. 2018; Nieminen 2020a). The validity of our approach can be measured in terms of whether we have successfully revealed new information about the role of assessment in knowledge production processes. To supplement our perspective, we encourage future studies to address epistemic injustice in assessment using deeper data sets in multiple contexts and through multiple approaches, ranging from psychological to sociocultural, and from interventions to policy analyses. Importantly, other stakeholders such as teachers and policy makers could be the focus of future research. Future studies could draw on design-based participatory approaches in order to both investigate and *change* assessment practices – and their contexts – in a scientifically rigorous way.

Conclusion: the ethics of knowing

We have argued that the way in which assessment restricts the students' epistemic resources is contrary to the overall purpose of higher education, which is to produce knowers. Finally, we conclude by demonstrating the ethical issues regarding epistemic injustice. As Fricker (2015) stated, preventing a person's epistemic recognition and contribution is an issue of ethics. Walker (2020, 276) makes a similar argument in the context of higher education:

> Who has access to and is able to secure epistemic benefits and hence epistemic goods, and how and to whom these are distributed in and through higher education practices and contexts is no small matter. Perpetrating epistemic harms and 'bad' epistemic dispositions which impede acquiring critical knowledge and reasoning practices are profoundly unjust.

As seen in our findings, assessment plays an active and important role in such ethical processes. In our study, the students regarded the epistemic nature of mathematics as restricting the repertoire of assessment practices. At the same time, assessment restricted the students' views of what it takes to epistemically know and do mathematics. Thus, it is crucial for both practitioners and assessment researchers to recognise the non-neutral role that assessment plays in the knowledge production processes of higher education. This is also a call for psychologically-orientated assessment researchers. In higher education, it might be worth shifting our gaze from 'performance' to 'knowledge'. We have only started the discussion between educational assessment and epistemology, and we hope there will be fruitful conversations and collaboration between these fields in future research.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Juuso Henrik Nieminen 🄳 http://orcid.org/0000-0003-3087-8933
Juulia Lahdenperä 🄳 http://orcid.org/0000-0003-2430-8811

References

Ashford-Rowe, K., J. Herrington, and C. Brown. 2014. "Establishing the Critical Elements that Determine Authentic Assessment." *Assessment & Evaluation in Higher Education* 39 (2): 205–222. doi:10.1080/02602938.2013.819566.

Bearman, M., and R. Luckin. 2020. "Preparing University Assessment for a World with AI: Tasks for Human Intelligence." In *Re-imagining University Assessment in a Digital World*, edited by M. Bearman, P. Dawson, R. Ajjawi, J. Tai, and D. Boud, 49–63. Cham: Springer.

Boud, D., P. Dawson, M. Bearman, S. Bennett, G. Joughin, and E. Molloy. 2018. "Reframing Assessment Research: Through a Practice Perspective." *Studies in Higher Education* 43 (7): 1107–1118. doi:10.1080/03075079.2016.1202913.

Boud, D., and N. Falchikov. 2006. "Aligning Assessment with Long-Term Learning." *Assessment & Evaluation in Higher Education* 31 (4): 399–413. doi:10.1080/02602930600679050.

Boud, D., and R. Soler. 2016. "Sustainable Assessment Revisited." *Assessment & Evaluation in Higher Education* 41 (3): 400–413. doi:10.1080/02602938.2015.1018133.

Braun, V., and V. Clarke. 2020. "One Size Fits All? What Counts as Quality Practice in (Reflexive) Thematic Analysis?" *Qualitative Research in Psychology*. Advance online publication. doi:10.1080/14780887.2020.1769238.

Brough, M. 2013. "Toward Cultural Epidemiology: Beyond Epistemological Hegemony." In *When Culture Impacts Health: Global Lessons for Effective Health Research*, edited by C. Banwell, S. Ulijaszek, and J. Dixon, 32–44. London: Academic Press.

Carnell, E. 2007. "Conceptions of Effective Teaching in Higher Education: Extending the Boundaries." *Teaching in Higher Education* 12 (1): 25–40.

Cohen, L., L. Manion, and K. Morrison. 2018. *Research Methods in Education* (8th ed.). London: Routledge.

Doan, M. 2018. "Resisting Structural Epistemic Injustice." *Feminist Philosophy Quarterly* 4 (4). doi:10.5206/fpq/2018.4.6230.

Dotson, K. 2014. "Conceptualizing Epistemic Oppression." *Social Epistemology* 28 (2): 115–138. doi:10.1080/02691728.2013.782585.

Flores, M. A., G. Brown, D. Pereira, C. Coutinho, P. Santos, and C. Pinheiro. 2020. "Portuguese University Students' Conceptions of Assessment: Taking Responsibility for Achievement." *Higher Education* 79 (3): 377–394.

Fricker, M. 2007. *Epistemic Injustice: Power and the Ethics of Knowing*. New York: Oxford University Press.

Fricker, M. 2015. "Epistemic Contribution as a Central Human Capability." In *The Equal Society*, edited by G. Hull, 73–90. Lanham: Lexington Book.

Gergen, K. J., and E. J. Dixon-Román. 2014. "Social Epistemology and the Pragmatics of Assessment." *Teachers College Record* 116 (11): 1–22.

Hanafin, J., M. Shevlin, M. Kenny, and E. Mc Neela. 2007. "Including Young People with Disabilities: Assessment Challenges in Higher Education." *Higher Education* 54 (3): 435–448. doi:10.1007/s10734-006-9005-9.

Häsä, J. I. A., J. Rämö, and J. H. Nieminen. 2021. "Supporting Quality of Learning by Letting Students Give their Own Grades – An Innovative Self-Assessment Model in University Mathematics." In *Assessment as Learning: Maximising Opportunities for Student Learning and Achievement*, edited by Z. Yan, and L. Yang, 232–243. London: Routledge.

Hofer, B. K. 2001. "Personal Epistemology Research: Implications for Learning and Teaching." *Educational Psychology Review* 13 (4): 353–383. doi:10.1023/A:1011965830686.

Iannone, P., and A. Simpson. 2019. "The Relation Between Mathematics Students' Discipline-Based Epistemological Beliefs and their Summative Assessment Preferences." *International*

Journal of Research in Undergraduate Mathematics Education 5 (2): 147–162. doi:10.1007/s40753-019-00086-5.

Knight, S., S. B. Shum, and K. Littleton. 2014. "Epistemology, Assessment, Pedagogy: Where Learning Meets Analytics in the Middle Space." *Journal of Learning Analytics* 1 (2): 23–47. doi:10.18608/jla.2014.12.3.

Koskenoja, M. J., S.-L. M. Varvio, J. P. Piiroinen, A. Leivonen, T. Lehtonen, J. Nuutinen, and N. Rantanen. 2018. "DIGest: Digital Method for Self and Peer Assessment of Exercises in Mathematics and Statistics University Studies." In *4th e-Learning Excellence Awards 2018: An Anthology of Case Histories*, edited by D. Remenyi, 123–130. Athens: Academic Conferences and Publishing International Limited.

Lahdenperä, J., and J. H. Nieminen. 2020. "How Does a Mathematician Fit in? A Mixed-Methods Analysis of University Students' Sense of Belonging in Mathematics." *International Journal of Research in Undergraduate Mathematics Education* 6: 475–494. doi:10.1007/s40753-020-00118-5.

Lincoln, Y. S., and E. G. Guba. 1985. *Naturalistic Inquiry*. California: Sage Publications.

Lucas, U., and P. L. Tan. 2013. "Developing a Capacity to Engage in Critical Reflection: Students 'Ways of Knowing' within an Undergraduate Business and Accountancy Programme." *Studies in Higher Education* 38 (1): 104–123. doi:10.1080/03075079.2011.569706.

McLean, M., A. Abbas, and P. Ashwin. 2018. *How Powerful Knowledge Disrupts Inequality: Reconceptualising Quality in Undergraduate Education*. London: Bloomsbury Academic.

Nieminen, J. H. 2020a. "Disrupting the Power Relations of Grading in Higher Education through Summative Self-Assessment." *Teaching in Higher Education*. Advance Online Publication. doi:10.1080/13562517.2020.1753687.

Nieminen, J. H. 2020b. "Student Conceptions of Assessment Accommodations in University Mathematics: An Analysis of Power." *Nordic Studies in Mathematics Education* 25 (3-4): 27–49.

Nieminen, J. H., H. Asikainen, and J. Rämö. 2019. "Promoting Deep Approach to Learning and Self-Efficacy by Changing the Purpose of Self-Assessment: A Comparison of Summative and Formative Models." *Studies in Higher Education*. Advance Online Publication. doi:10.1080/03075079.2019.1688282.

O'Donovan, B. 2017. "How Student Beliefs about Knowledge and Knowing Influence their Satisfaction with Assessment and Feedback." *Higher Education* 74 (4): 617–633. doi:10.1007/s10734-016-0068-y.

Patton, C. 2012. "'Some Kind of Weird, Evil Experiment': Student Perceptions of Peer Assessment." *Assessment & Evaluation in Higher Education* 37 (6): 719–731. doi:10.1080/02602938.2011.563281.

Penuel, W. R., and D. A. Watkins. 2019. "Assessment to Promote Equity and Epistemic Justice: A Use-Case of a Research-Practice Partnership in Science Education." *The ANNALS of the American Academy of Political and Social Science* 683 (1): 201–216. doi:10.1177%2F0002716219843249.

Raaper, R. 2019. "Students as Consumers? A Counter Perspective from Student Assessment as a Disciplinary Technology." *Teaching in Higher Education* 24 (1): 1–16. doi:10.1080/13562517.2018.1456421.

Rämö, J., D. Reinholz, J. Häsä, and J. Lahdenperä. 2019. "Extreme Apprenticeship: Instructional Change as a Gateway to Systemic Improvement." *Innovative Higher Education* 44 (5): 351–365. doi:10.1007/s10755-019-9467-1.

Saldaña, J. 2016. *The Coding Manual for Qualitative Researchers*. Thousand Oaks, CA: Sage.

Shotwell, A. 2017. "Forms of Knowing and Epistemic Resources." In *The Routledge Handbook of Epistemic Injustice*, edited by I. J. Kidd, J. Medina, and G. Pohlhaus, Jr, 79–88. Milton Park: Routledge.

Smith, C. D., K. Worsfold, L. Davies, R. Fisher, and R. McPhail. 2013. "Assessment Literacy and Student Learning: The Case for Explicitly Developing Students 'Assessment Literacy'." *Assessment & Evaluation in Higher Education* 38 (1): 44–60. doi:10.1080/02602938.2011.598636.

Solomon, Y., and T. Croft. 2016. "Understanding Undergraduate Disengagement from Mathematics: Addressing Alienation." *International Journal of Educational Research* 79: 267–276. doi:10.1016/j.ijer.2015.10.006.

Struyven, K., F. Dochy, and S. Janssens. 2005. "Students' Perceptions about Evaluation and Assessment in Higher Education: A Review." *Assessment & Evaluation in Higher Education* 30 (4): 325–341. doi:10.1080/02602930500099102.

Tan, K. H. 2004. "Does Student Self-Assessment Empower or Discipline Students?" *Assessment & Evaluation in Higher Education* 29 (6): 651–662. doi:10.1080/0260293042000227209.

Tanswell, F. S., and C. J. Rittberg. 2020. "Epistemic Injustice in Mathematics Education." *ZDM Mathematics Education* 52: 1199–1210. doi:10.1007/s11858-020-01174-6.

Taras, M. 2015. "Situating Power Potentials and Dynamics of Learners and Tutors within Self-Assessment Models." *Journal of Further and Higher Education* 40 (6): 846–863. doi:10.1080/0309877X.2014.1000283.

Walker, M. 2020. "Failures and Possibilities of Epistemic Justice, with Some Implications for Higher Education." *Critical Studies in Education* 61 (3): 263–278. doi:10.1080/17508487.2018.1474774.