EDUCATIONAL DESIGNER

JOURNAL OF THE INTERNATIONAL SOCIETY FOR DESIGN AND DEVELOPMENT IN EDUCATION

# Developing Guidelines for Assessment and Resource Design In Mathematics Education to Support Equity, Diversity, Inclusion, and Belonging

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## Abstract

*Increasingly in our work as designers in mathematics education, we are conscious of, and grappling with, systemic issues of marginalisation and proximity to power. It is apparent that much work needs to be done to ensure that mathematics education is a welcoming space for students with a wide range of historically minoritised identity markers. This paper reports on the design and development of a set of guidelines intended to support designers through a process of attention focusing on issues of equality, diversity, inclusion, and belonging in order to create mathematics education resources that support access to mathematics for students whatever their identities. The guidelines themselves are published separately on the website cambridgemaths.org. We invite readers to explore the guidelines in their draft form, critique them fully, and use them freely.*

## Background

Organisations in mathematics education typically emphasise the importance of making the subject accessible, welcoming, and inclusive—and yet meaningful, systemic change in school mathematics education is often hard to identify. While there exist isolated examples of good practice—for example inclusive pedagogies, resources that incorporate a more diverse range of maths or mathematicians, or demographically targeted interventions—there remains a pervasive sense that mathematics welcomes some of our students, while maintaining invisible barriers for others:

> *sometimes I dread going into [maths], 'oh now I've got maths' but I think that's just because of the … stigma attached to maths…And women are still um second-class. I mean I've heard that said a lot but I don't know how true it is … It's becoming less and less true, but I think it is, it is true in sort of, in terms of the hard facts it is. Like figures and stuff. Who has what jobs, who earns what, who owns what, who has power, stuff. (Claudia, student in Mendick, 2005, p. 237)*

We (the authors) characterise this as an *action gap* between the warm words and positive intentions embedded in statements of intent and the 'real world' of the ways in which issues of equity, diversity, inclusion, and belonging (EDIB) are accounted for through the decisions, policies, and output of organisations and individuals working in mathematics education. While many of us feel a moral or ethical imperative to support efforts to make our subject more inclusive, there remains a strong sense that mathematics as a subject is cold, hard, and rational, somehow exempt from the realm of social conflict due to its objectivity and beauty. In fact, mathematics is as human an activity as any other, encoding values, beliefs and prevailing orthodoxies through its enaction; even the choice about what constitutes valid, or valued mathematical activity is a choice (Morgan, 2001).

It is increasingly the case that organisations recognise the need to consider some aspects of EDIB within the context of their activities and culture, if only for economic reasons. According to Mckenzie-Delis, "*The business case for diversity is now widely accepted… being more diverse and inclusive equals better business – from a profit, performance, and growth perspective; from an innovation, brand equity, and productivity perspective; and from a talent attraction, engagement, and retention perspective.*" (McKenzie-Delis, 2019, p. 257). It is in this context that Cambridge Mathematics (an organization born of a partnership between Cambridge University Faculties of Education, and of Mathematics, and Cambridge University Press and Assessment) developed guidelines for assessment and resource design in mathematics education. The guidelines were to be used as an internal document by Cambridge University Press and Assessment designers. But, they were also to be freely available to the wider mathematics education design community to support design directly and to contribute to the contested space of dialogue around EDIB in mathematics education. Although our focus as guideline authors is mathematics education and these guidelines have therefore been developed with mathematics in mind, much of the literature cited and therefore many of the recommendations in the guidelines are more general. We therefore believe that our work can be thoughtfully adapted to apply to educational design more generally, or to other disciplines. We intend these guidelines to support those who already want to make different design choices but do not yet know how, and those who do not yet realise they can (and should) make design choices that acknowledge issues of EDIB.

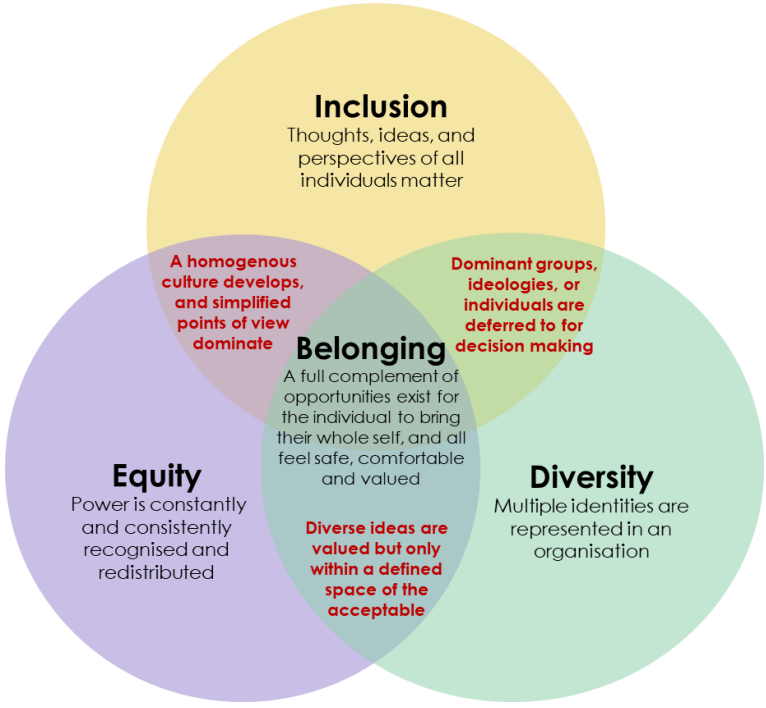
Stepping into this space is fraught, with a stark gap between good intentions and potential risk. By this we mean that it is easy to make abstract statements around EDIB, but as soon as one takes any concrete action one is open to criticism, both for the action being 'wrong', and for not doing everything possible. For example, if one claims one is running an accessible conference, the pathway is fraught with difficulties which would not be present had one not claimed that actions were being taken to ensure accessibility in the first place. Furthermore, setting out concrete actions to address EDIB concerns may leave organisations and individuals open to criticism from a sometimes hostile media and stakeholders with different priorities including commercial imperatives, political maneuvering, and outrage farming. In short, many feel, and perhaps with justification, that it is easier to do nothing and claim good intentions than to put those intentions into practice, even if this is only to capture more detail in writing. Perhaps this explains why there are few guidelines of this type published publicly. It is understandable that for many, doing nothing and saying nothing specific feels safer; a generic statement affirming a commitment to EDIB is clearly less of a risk than explicitly stating what this actually means, in practical terms, to the individual or organization, and opening the way for potentially uncomfortable critique and criticism this entails. Further, many of us are not yet used to asking an important question: what have you had to sacrifice for this vision? This tension is further exacerbated by the rapid pace of change as issues of EDIB become

more visible, understood (or misunderstood), contested, and hence more in conflict with the prevailing orthodoxy. We are conscious of how our own lived experiences constrain our perspectives, direct our attention, and potentially result in awareness gaps. The mere fact that we are in a position to write and publish guidelines is ample evidence that we benefit and have benefitted strongly from a set of privileges. Having had few direct personal experiences with marginalization in mathematics, we must take care while conceptualising our understanding of the issues and their implications. We therefore invite readers to engage with the guidelines, critique them, and challenge our assumptions in order to further refine and improve them.

## What is EDIB?

Equity, diversity, inclusion, and belonging constitute a set of interrelated elements that together attend to the imbalances of power and privilege that can be observed in our societies and the institutions that reflect them. While the basic ideas of EDIB can be expressed using different words and versions, we adopt a model in which *belonging* sits at the heart of EDIB work. A sense of belonging is highly contextual, depending on a complex interaction of social, environmental, and systemic factors, but can be defined as "*a subjective feeling of value and respect derived from a reciprocal relationship to an external referent that is built on a foundation of shared experiences, beliefs or personal characteristics*" (Mahar et al., 2013, p. 1031). This sense of belonging is an emergent element, only achieved when equity, inclusion, and diversity are embedded in cultures and practices (Figure 1). Further, half-hearted or piecemeal approaches to EDIB work, which do not acknowledge the totality and depth of the work necessary, may even be actively harmful and constitute a form of tokenism (Servaes et al., 2022). This tokenism may create a superficial impression of progress that further reinforces the conditionality of access to power for minoritized members of a community. Under these circumstances a sense of belonging remains unobtainable, while at the same time it becomes harder to voice discontent with the status quo and break through the veneer of seemingly positive actions taken.

**Figure 1 – Components of EDIB (adapted from Krys, 2019)**

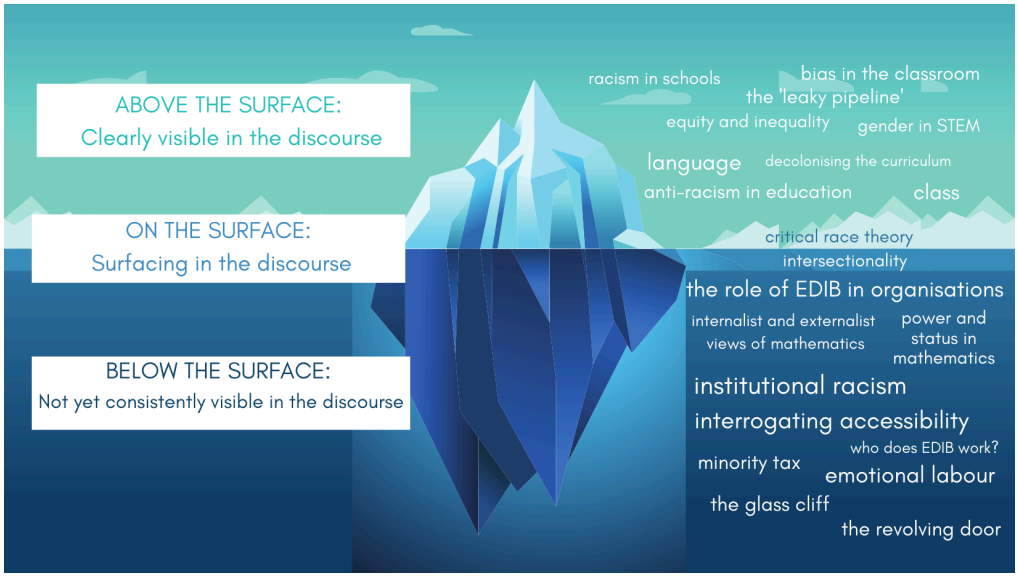


As educational designers, we have an important role to play in supporting the embedding of EDIB within the education system at every stage of the design cycle, and to continually educate ourselves about EDIB. And yet, so often this does not happen because it is hard work and work that is almost always unvalued, unrecognised, and under-resourced (and often unpaid!). Initiatives often include very visible action such as developing resources that draw attention to minoritised voices within the history of STEM subjects, celebrating the often-erased contributions of mathematicians, engineers, and scientists that do not fit neatly into "acceptable" White, Western, male, cisgendered paradigms. The initiatives can also involve attempts to decolonise curricula, in which a more diverse range of sources, skills, and ways of seeing are embedded and valued (e.g. Foster et al., 2022). While important, these initiatives do not necessarily attend to the invisible signalling that is communicated through every word and image of a designed resource. According to Code, "*Received values—epistemic, social, moral, political, ontological—deeply if silently embedded in, yet constitutive of, the dailiness…of "everyday life" carry a normative force whose (often silent) power demands recognition in thought and action.*" (Code, 2020, p. xx). Designers must be ever conscious of this normative force shaping design decisions and subsequent actions.

Of course, EDIB cannot be addressed sufficiently through resource design alone: issues relating to EDIB are systemic, arising from wider systems of culture and values at national, supra-national, and local levels (e.g. Peters, 2015; Sadker et al., 2009; Yeh & Rubel, 2020). This systemic inertia is pernicious; Gillborn, for example, suggested that "*conventional forms of anti-racism have proven unable to keep pace with the development of increasingly racist and exclusionary education policies that operate beneath a veneer of professed tolerance and diversity*" (Gillborn, 2006, p. 11).

We find it useful to visualise this as an iceberg (Figure 2) with some issues visible above the surface. These are easy to acknowledge if not always easy to act on. Other issues sit on the surface, providing some window into the depths below. But, below the surface sit a multitude of unacknowledged or contested elements that are not routinely visible to all and as such remain unconsidered in design choices and policies.

**Figure 2 – Issues related to EDIB as an iceberg**



The above-the-surface elements may prove a tempting starting point, and we are supportive of all initiatives to address these. But, there exists a danger that just focusing on these cannot deliver lasting, systemic change, and may in fact cause further harm by embedding a narrative of "job done", or at least "sufficient progress made". Furthermore, there is no single universal version of the iceberg in Figure 2. As with real natural phenomena, dynamic change over time and place is to be expected, and perspectives differ depending on point of view. The intention of including this figure is to provoke the reader to consider what is visible, emerging, and below the surface in their experience, and why this may be the case—as discourses are shaped by power expressed in voices and silences.

## Designing the Guidelines

In order to design the guidelines, we began with an open-ended, exploratory literature review, intended to identify our design goals and principles. We used a process of thematic synthesis with the aim of achieving conceptual saturation (Thomas & Harden, 2008) in order to identify key themes and ideas. We have used this approach extensively in our work on the Cambridge Mathematics Framework (e.g. Jameson, 2019) as a way of synthesizing information from a broad range of sources to address a complex topic. Using this approach, we immersed ourselves in writing and research around issues of race, gender, disability, sexuality etc. using a corpus of material that included academic writing in the form of journal articles and academic books, and popular writing such as blogs, magazine/internet articles, and books. This reading included material in general education and mathematics education contexts, but also reached beyond this into a more general space. To engage in a process of conceptual saturation is to immerse oneself in the literature, following the narrative, philosophical, and theoretical threads where they lead and building a sense of the space. As ideas and themes arise, they are acknowledged and added to until few new themes arise, and additional reading no longer adds substantial new ideas to that which have already been established. At this point, conceptual saturation can be considered to have occurred.

The process was semi-systematic, relying on casting a wide net in order to minimize selection bias (Thomas & Harden, 2008). We further addressed some of the inherent risk of bias by co-writing the design guidelines, which meant multiple authors identified sources of literature independently and used different approaches. Furthermore, a key design principle that we established early was that given the contested, and constantly changing nature and awareness of the issues that must be considered within EDIB work, the guidelines will forever remain in draft form.

While engaged in the process of reviewing for conceptual saturation, we became sensitive to a number of tensions arising between the narrative strands that emerged and the practical constraints of the guidelines we were seeking to develop. We also began to develop a sense of some key considerations that would eventually inform the final guidelines that we produced (Table 1).

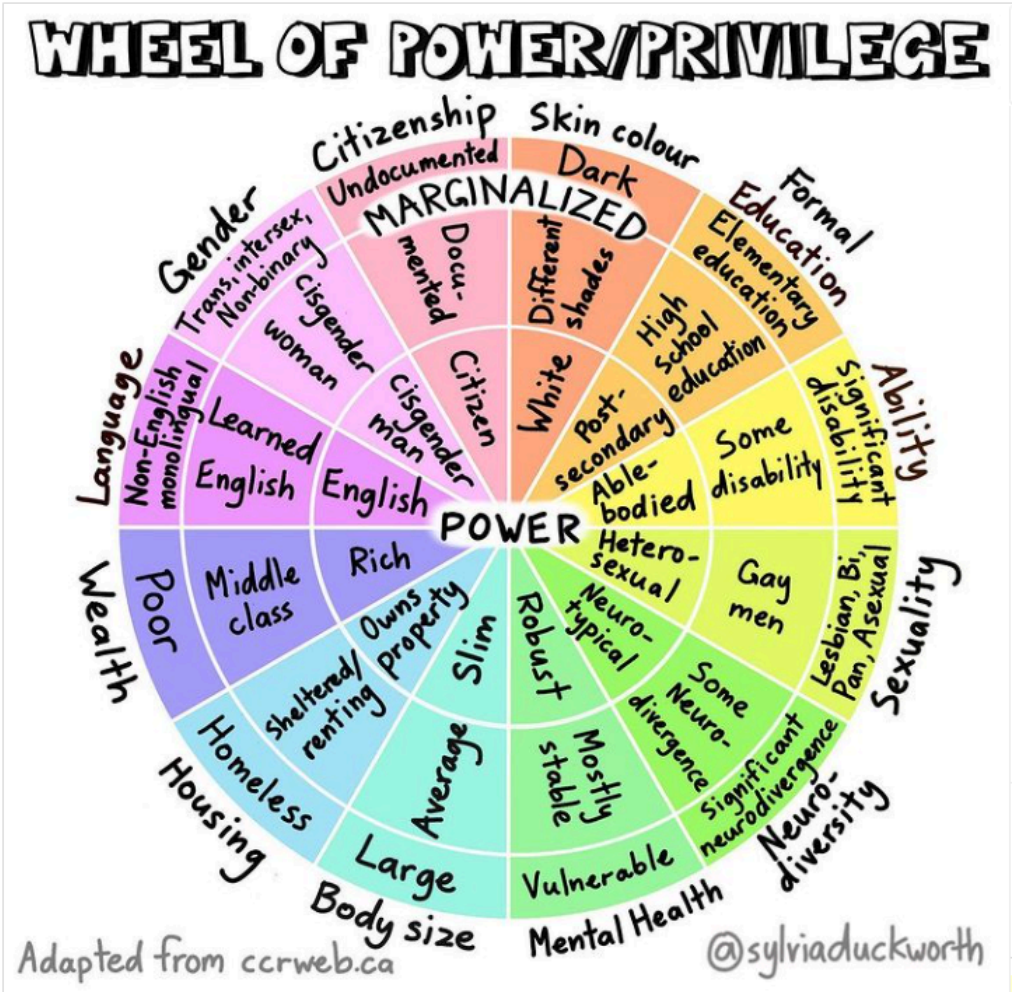
**Table 1 – Considerations and constraints**

| Issue | Description |
|---|---|
| Tension between useful/useable and comprehensive | The guidelines must be comprehensive in order to capture the range of minoritized identities impacted by a lack consideration of EDIB, and must acknowledge that, while these identities and the related issues of a lack of inclusion intersect, they are also unique and complex. At the same time, the guidelines must be useable and therefore cannot be too long or complex. |
| Commercial considerations | While designed to be used by the wider design community in mathematics education, many organizations that may use them operate in jurisdictions and/or commercial environments in which these ideas are contested or controversial. The guidelines must be accessible and robustly evidenced in order to ensure they are defensible. |
| EDIB as a lens, not a checklist | It would not be possible, nor desirable to create guidelines which operate as a checklist which could be used to "tick off" whether a resource is in some sense EDIB compliant. A checklist which was useable would not be comprehensive, and a comprehensive checklist would not be useable. The guidelines should act as a tool to help designers to develop an EDIB lens through which they view all their design work. |
| EDIB as a dynamic and ever evolving field | Issues of EDIB are contentious, contested, and rarely settled. As a result, the guidelines must acknowledge that they will not remain current for long. |
| Particular/general | There is a tension between identifying and exemplifying specific issues of EDIB unique to certain minoritized identities and referring to general issues that cut across multiple identities. The complex interplay between identities is reflected in the complex interplay between any recommendations in the guidelines. |

EDIB guidelines must account for a broad range of intersecting identities operating in what has been characterized as a matrix of oppression (Adams & Zúñiga, 2016). One way in which this can be usefully conceptualised is through the wheel of power/privilege (Figure 3). This framing considers the issue of EDIB in relation to proximity to power—a well-established perspective on Whiteness (e.g. Garay et al., 2022) in particular and privilege more broadly.

The wheel identifies a number of identities and how these present in relation to power and minoritisation. For example, it situates cis-male, cis-female, and transgender identities within gender in terms of their proximity to power. While a powerful tool for surfacing many of the identities that are less well attended to when considering EDIB, the wheel is not without its own issues, appearing to superficially present identity markers as static, well defined, and comprehensive. It is important therefore to recognize the wheel as a snapshot in which identity markers exist on a spectrum, with proximity to power, and even the markers themselves, dependent on contexts that may change across time periods and locations.

**Figure 3 – Wheel of power/privilege (Duckworth, 2020)**




Speaking in the context of mathematical activity, Mason suggested that

> *"What we attend to is also described as what we are aware of. But these are different from what we are conscious of. For example, I know that you know how to breathe, and to regulate your breathing. I conjecture that until I mentioned breathing, you were unaware of either your breathing or your powers of regulation. Thus awareness is not simply consciousness." (Mason, 2003, p. 23)*

This idea of attention can be applied to EDIB work through the lens of the wheel of power/privilege. To design educational materials that attend comprehensively to issues of EDIB, the guidelines must direct attention to a broad range of issues related to identity, power, and privilege. By bringing issues into the awareness of designers, the guidelines seek to help designers attend to those issue in a meaningful way. In a sense, the guidelines act as a bridge between the unique set of identities that comprise the lived experience of the designer, and the lived experiences of all those students and teachers who may interact with the educational artefacts they produce.

We characterize the guidelines as a tool for bringing awareness to the importance of ethical micro-decisions in educational design. In particular, they support the designer to develop an EDIB lens that allows them to make ethical micro-decisions as a fundamental feature of their design work. The concept of microethics developed from decision making in medicine, but has more recently been applied more broadly, including in education (e.g.

Bezuidenhout & Ratti, 2021). Micro-decisions refer to the myriad, often unconscious, decisions designers make while negotiating their identities and are defined by their own socially-constructed realities (Tirres, 2021).

In the last decade in mathematics education, variation theory (Mason et al., 2009) has become more prominent, and educators and task designers have begun to consciously pay more attention to the importance of micro-decisions and their consequences in terms of mathematical content (e.g. Watson & Mason, 2006). We are proposing an extension of these ideas into the EDIB realm which supports access and inclusion for a wider range of students. Therefore, the micro-decisions we all make send strong signals about what we value, and of what we are aware. As designers, these micro-decisions have an authority, which becomes forever solidified within a design artifact, and therefore have disproportionate power to reinforce or subvert norms and power structures through the reproduction and use of the artifacts in educational contexts far removed from the immediate sphere of the designer. It is essential therefore in an EDIB context that these micro-decisions have an ethical dimension, that designers become aware that the most insignificant seeming choice of example may send invisible signals that elevate, or further erase the identities of the students and teacher who interact with them.

Initially then, the guidelines are designed to support design work through frequent reference. But the ultimate goal is that these ethical micro-decisions should become embedded as a fundamental part of the design process, supplemented by independent reading and an ever-evolving awareness of the fluctuating EDIB landscape. In a very real sense, the guidelines will be effective if they ultimately render themselves redundant to the individual designer, whose EDIB lens has developed in scale and sophistication beyond that which is captured by the guidelines themselves.

# Design Principles and Structure

Arising from the literature review, we established a set of design principles to inform the decisions that we made as we developed the guidelines:

## Permanently in Draft Form

The guidelines can never be considered ‘finished’ as there will always be new considerations to include within their scope. Social structures are not static, and identities that today are invisible or contested may not remain so in the future. Therefore, the focus and level of exemplification needed with regard to particular identities will require an ongoing process of revision, refinement, and supplementation.

## Open to Critique/Feedback

The guidelines are intended to be a working document, and therefore must be both useful and useable. Furthermore, this is a contested space with new perspectives, theories, principles, and best practices being developed. An ongoing process of engagement and feedback is essential to ensure that the guidelines remain current, valid, and inclusive. We have used these guidelines as a resource for delivering EDIB training to colleagues, designers, and teachers, and we invited critique directly during these sessions. Furthermore, the guidelines are published on cambridgemathematics.org, and we invite readers of this paper to contact us (the authors) if they have comments or feedback.

## Freely Available

While developed for use within a specific organisation, the guidelines should be freely available in order to support efforts across the wider mathematics community to engage in EDIB work. This may also have the effect of opening the space and 'normalising' the inclusion of EDIB considerations in all design work, rather than just that of organisations and individuals with the resources to engage with these issues.

## Based in Evidence

We recognised the contested nature of the space and the fact that EDIB considerations may conflict with other considerations such as commercial sensitivities and the cultural norms of the social context for which educational artifacts are being designed. We therefore required the current evidence base for the guidelines to be sufficiently robust to be defensible.

## Contains Exemplification

In order to be useful and useable, the more abstract ideas of inclusion and representation should be sufficiently exemplified. This exemplification enables designers to easily make the connection between the ideas expressed in the guidelines and their relation to the design context in which the designer is operating. Many of the minoritized identities under consideration will be outside of the lived experience of the designer, and so the guidelines must bridge this divide in an accessible way through descriptive examples.

## Illustrative Rather than Prescriptive

The guidelines are not designed as a checklist that can be applied to design work in order to "tick off" EDIB. The issues are complex and intersectional, leading to unique considerations in different design contexts which cannot be captured in anything but the most superficial way through a set of prescriptive EDIB actions. As a result, the guidelines must be illustrative of the space of ethical micro-decision making, which the designer can interpret and apply to their unique set of design considerations and constraints.

These design principles were used to produce an initial draft of the guidelines, structured to reflect where EDIB considerations are most apparent in mathematical activities. The structure reflects the kind of support enquiries we receive from colleagues designing mathematics-based education products in our professional activities. We undertook an iterative drafting process through which the guidelines were shared first with a small group of colleagues with mathematics expertise, and then with a larger group of colleagues with a range of expertise in design and education contexts, not always including mathematics education. At each stage, feedback was incorporated into the next draft. This process resulted in the guidelines being divided into four sections: general design principles, images, language, and data. While many of the design principles are generalisable to other areas of education, the chosen structure is most closely aligned to mathematics, and we would anticipate that any adaptation of these guidelines for use in a different educational context would benefit from a restructuring activity to contextualise them appropriately. Table 2 provides some examples of specific elements from the guidelines document, and the section from which they came.

**Table 2 – Examples of elements from the guidelines (adapted from Rycroft-Smith & Macey, 2022a)**

| Section | Element |
|---|---|
| General design principles | "The intention is not that EDIB concerns obscure or overwhelm the mathematical intent but that the micro-decisions related to the chosen context are taken with attention to EDIB consequences." (p.1) |
| Images | "Avoid unnecessary exaggerations, one-note depictions, stereotypes, caricatures and cultural clumsiness – for example, big pink bows or eyelashes to denote femininity; use of a walking stick to denote age; only denoting disability with the use of a wheelchair." (p.2) |
| Language | "When writing about other people's thinking in order to critique it, be particularly careful about who is 'incorrect' in their thinking in relation to stereotype threats in mathematics." (p.2) |
| Data | "Be aware that data are a product of many biases at many stages and be aware of 'mathwashing': the tendency to ascribe neutrality or legitimacy to data, forgetting that they have been collected, collated, analysed and reported by humans." (p.3) |

The section focusing on data arose in response to evidence from literature and discussions around both the ethics of data and the historic associations of racist practices with the development of many familiar statistical techniques (Rycroft-Smith & Macey, 2022b). This section, in particular, reinforces the idea that the ethical micro-decisions that designers take can have surprising significance and reinforce potentially harmful norms and false beliefs. For example, something as simple as choosing to segment a data set by two gender categories embeds a binary narrative that many would question. In addition, depending on what is being compared, this design choice could help reinforce negative stereotypes.

# Discussion

The guidelines are presented as a work in progress document, intended to evolve over time in response to a changing EDIB landscape. We believe that however well-designed or well-used a document such as this may be, it can never be sufficient or effective in isolation because we are dealing with a systemic issue. The work of educational designers is important, but must be supported more widely by changes in institutional culture at all levels of the education system, and support for teachers in the classroom to embed EDIB into their own teaching and learning as an initially conscious act.

Ultimately, while the guidelines are intended to be used as a tool for supporting EDIB inclusive design in mathematics education, we found that by the end of this initial design process, we were no longer thinking about it purely as a design framework. Rather, we now consider it a tool for the continuing professional development of education designers. It acts not as a checklist, but as a focusing mechanism for the EDIB lens of the designer, drawing attention to some important issues of identity and EDIB as a starting point for the real work in this space that every design needs to do as an ongoing process.

Furthermore, although designed with mathematics education in mind, there is no need for these guidelines to be used purely within the context of mathematics, and we would invite designers in the wider education community to critique their utility and applicability to other subjects. The act of adaptation itself, if done thoughtfully and drawing on additional relevant literature, may help users gain additional insight into EDIB in their own areas of specialism, and constitute an act of professional learning in its own right.

We intend these guidelines to help expand the space of possibility that designers consider in their work and motivate them to explore the issues further independently in order to gain a deeper and rounder understanding that becomes embedded in the process of ethical micro-decision making that informs all of their work. According to hooks "*There can be no intervention that challenges the status quo if we are not willing to interrogate the way our presentation of self as well as our pedagogical process is often shaped by middle-class norms*" (hooks, 1994, p. 185). These guidelines are intended as an artefact of subversion, assisting in the process of challenge to power by providing the designer with access to a way of seeing that extends beyond the immediate, the visible, and the personal, and allowing the designer to access considerations beyond these middle-class norms.

It remains the case, however, that these design guidelines are necessary precisely because of the need for greater diversity, equity, and inclusion throughout the mathematics education community. Fostering an inclusive and diverse environment within design teams is a longer-term destination and it is our hope that these guidelines can act as a necessary short-term tool which is ultimately rendered redundant by ensuring that a plurality of lived experience is represented within and throughout the whole community of designers, embedding the richness of perspective that this brings.

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## Accessing the Guidelines

The full guidelines can be found on the Cambridge Mathematics website and should be cited as:

Cambridge Mathematics. (2022). *Draft guidelines for assessment and resource design in mathematics education*. https://cambridgemaths.org/Images/651814-draft-guidelines-for-assessment-and-resource-design-in-mathematics-education.pdf

We invite readers to critique them, use them and share them widely. Whilst Darren Macey and Lucy Rycroft-Smith no longer work for Cambridge Mathematics, we are happy to

receive feedback on the guidelines. For comment and feedback, we can be contacted via djm249@cam.ac.uk.

## About the Authors

**Darren Macey** (Djm249@cam.ac.uk) is a former secondary mathematics teacher who worked in English secondary schools over a 10 year teaching career. On leaving the classroom he remained focused on mathematics education, initially providing professional support for teachers working on the development of Core Mathematics qualifications, and the redevelopment of GCSE and A-level mathematics. Darren is an education consultant and previously worked for Cambridge Mathematics for almost a decade. He has expertise in statistics education, professional learning, and assessment. He co-authored 'Teaching Statistics' (Cambridge University Press), is a member of the Royal Statistical Society Education Policy Advisory Group, and a trustee of the Teaching Statistics Trust. As a researcher Darren is interested in issues of ethics and inclusion, teacher agency, professional learning, and assessment design. He is currently completing his doctoral studies at the University of Cambridge, exploring how changes to the design of assessment items impact on pedagogy in statistics education.

A former mathematics teacher, **Dr Lucy Rycroft-Smith** (Lr444@cam.ac.uk) has worked in both the primary and secondary sectors, including as a Head of Mathematics in a secondary school, and as an Associate Lecturer for the Open University. She has been a freelance writer and speaker in education for fifteen years, writing for various organisations such as the BBC, the Guardian and Tes, and is the author of many articles and research papers on mathematics education, including intersections with EDIB and LGBTQIA identities. Lucy led on, designed and edited the flagship Espressos (summarised mathematics research documents) for Cambridge Mathematics for nine years, and has collaborated internationally and within the UK on a range of mathematics education design projects. She has a Master's and a PhD from the University of Cambridge, investigating the processes and products of knowledge brokering in mathematics education.



Macey, D., Rycroft-Smith, L. (2025) Developing Guidelines for Assessment and Resource Design In Mathematics Education to Support Equity, Diversity, Inclusion, and Belonging. *Educational Designer*, 5(18). ISSN 1759-1325
Retrieved from: http://www.educationaldesigner.org/ed/volume5/issue18/article74/