Discover Education

Perspective

Inclusive MOOCs as an antidote to stereotype threat in education: state of the art and future directions

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Abstract
This study examines the potential of inclusive design in Massive Open Online Courses (MOOCs) to address the impact of stereotype threat, a significant barrier encountered by underrepresented groups, particularly in STEM education. As online learning opportunities grow, the demographic composition of course participants frequently does not reflect broader societal diversity, with women and racial minorities remaining underrepresented in fields such as computer science and mathematics. This phenomenon reflects societal stereotypes that shape perceptions and constrain study choices. MOOCs, given their global reach, flexible structure, and often anonymous nature, have the potential to challenge these stereotypes when designed inclusively. This work synthesizes existing research and provides a broader perspective on strategies for fostering inclusivity in MOOCs through a systematic literature review, focusing on methods to counteract stereotype threat. The aim is to propose practical solutions for inclusive course design to empower marginalized learners and promote equitable education, enhancing the representation of marginalized learners in both educational and professional spheres. Furthermore, the findings of this study indicate the necessity for further investigation into the design of inclusive MOOCs, providing a future research agenda. This work contributes to the academic discourse on the potential of MOOCs to foster an integrated approach toward inclusive digital transformation in education, thereby enabling supportive digital inclusive learning environments. Moreover, it is of significant societal and organizational relevance, particularly in promoting diversity within STEM fields and beyond and creating a more equitable future where learners can flourish, regardless of background or prevailing stereotypes.

Keywords Inclusive education · Online education · MOOCs · Equality · Stereotype threat · Literature review

1 Introduction

Online learning has transformed education by making learning content accessible anytime and anywhere. However, despite the widespread availability of online courses, significant disparities persist in participation across gender, racial, and socioeconomic groups. Fewer women than men find their way into computer science courses [1], and racial minorities, such as Black students, are disproportionately absent from science, technology, engineering, and mathematics (STEM) fields [2]. In the United States, only 21% of bachelor's degrees in computer science are earned by women [3], reflecting systemic barriers that shape educational paths. These inequities endure despite decades of research and efforts to promote inclusion [4, 5].

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Part of the challenge stems from societal stereotypes that influence how certain groups are perceived in fields like computer science and mathematics [6, 7]. These stereotypes, which, for example, tend to envision computer science students as men [6], can result in stereotype threat, where individuals fear confirming negative stereotypes about their group, leading to reduced performance and engagement [9]. These barriers limit individuals' potential and hinder societal and economic progress by deterring marginalized groups from pursuing specific careers such as STEM. To address these issues, researchers call for a shift away from simplistic difference-based analyses (e.g., "males excel at X, females at Y") [10] and emphasize the need for equitable educational practices that minimize stereotype threat.

Massive Open Online Courses (MOOCs), with their global reach, flexible structure, and often anonymous nature [11], can address these challenges and offer a flexible and scalable educational model that can democratize learning globally [12, 13]. When designed inclusively, MOOCs can help challenge stereotypes and foster diverse participation—reaching out to learners from all walks of life.

Inclusive MOOC design aims at maximizing the quality of human-computer interactions [14, 15] by minimizing barriers for marginalized learners, like addressing cues that can trigger stereotype threat [14, 16, 17]. Specific strategies include fostering supportive environments and leveraging tools like conversational agents, also known as digital assistants or chatbots [18], which can provide personalized, context-sensitive assistance to learners [19, 20] and cater to diverse needs, promoting inclusivity and enhancing learners' engagement and performance [21]. This article defines inclusive design within MOOCs as prioritizing diversity and addressing the needs of groups vulnerable to stereotype threat in education. These design solutions seek to minimize cues that can create stereotype threat while enhancing the participation of these groups in education and careers in traditionally stereotyped fields.

While inclusive MOOC design can mitigate stereotype threat, it is not a cure-all for systemic issues underlying stereotypes and biases. Inclusivity requires a comprehensive approach, involving societal, organizational, and individual efforts to reshape attitudes and address systemic biases that perpetuate inequality and affect individuals' well-being in a digital world [22]. The objective of this study is to enhance awareness of this challenge and contribute to equity in education through inclusive MOOC design, in alignment with the goals of the United Nations and the European Union, which are to ensure inclusive and equitable quality education, to challenge and dissolve stereotypes, particularly those that constrain the field of study choices, and to promote lifelong learning opportunities for all [23, 24]. Additionally, this study contributes to fair participation in a digitalized world and to well-being in human-computer interaction [26]. Therefore, two research questions are put forth for investigation:

- RQ1: What insights do prior studies provide on inclusive design for MOOCs to mitigate stereotype threat in education?
- RQ2: How might these insights be challenged, and what avenues emerge for future research?

After presenting the theoretical background and research methodology, a synthesis of previous literature (59 articles) on inclusive MOOC design for mitigating stereotype threat is presented. Existing literature is highly heterogeneous, often focusing on isolated solutions rather than a broader perspective. This study takes a meta-perspective, overviewing three key success indicators and six specific inclusive design solutions. By addressing research gaps, it offers a research agenda to inspire future research. This work contributes to reducing stereotypes in education, thereby contributing to equity and human flourishing in an information society.

2 Stereotype threat in education and inclusive MOOCs as an antidote: related work

Educational disparities in participation and performance are often rooted in stereotypes—generalized beliefs about groups' characteristics and behaviors [27, 28]. Such stereotypes can perpetuate self-fulfilling cycles, as evidenced by the case of a child who avoids mathematics due to a discrepancy between the stereotypical image of a mathematician and their self-identity [29]. "Stereotype Threat Theory" provides a robust framework for understanding how such barriers operate. According to Steele and Aronson [8], stereotype threat emerges when individuals fear being judged or treated according to negative stereotypes about their group, impairing performance and increasing the likelihood of disengagement. These effects may be triggered explicitly—such as through negative feedback about the group's abilities in that area—or implicitly, through environmental cues like underrepresentation of peers in a classroom [8]. Over time, stereotype threat can lead to disidentification with a domain, discouraging participation in fields like mathematics or computer science, where stereotypes about specific groups such as gender and racial differences persist [29, 30]. For instance, research shows that stereotype-reinforcing cues in educational materials can amplify feelings of exclusion and reduce motivation [32, 33]. Addressing these challenges is essential to dismantle self-reinforcing cycles of underrepresentation in education and careers.

MOOCs offer a unique opportunity to counteract stereotype threat due to their accessibility, scalability, and capacity for design innovation. Unlike traditional classroom settings, MOOCs provide an adaptable digital environment where interventions can be rapidly implemented and tested across millions of learners [14]. For example, anonymity in discussion forums may alleviate pressures associated with identity-based stereotypes [34, 35], while adaptive learning technologies can personalize content to accommodate diverse needs and reduce stereotype-reinforcing cues [36].

In recent years, research in Information Systems (IS) and Human–Computer Interaction (HCI) has a growing focus on social topics [36, 37]. In IS, diversity, equity, and inclusion have emerged as central concerns, with studies emphasizing the role of technology in fostering equity [36]. Similarly, HCI research highlights challenges like ethics, well-being, accessibility, and inclusion, particularly within technology-augmented contexts, as educational ones [37]. These efforts align with global initiatives like the United Nations Sustainable Development Goals (SDGs), which emphasize well-being (SDG3), quality education (SDG4), gender equality (SDG5), and reduced inequalities (SDG10) [23], as well as European Union efforts advocating for digital inclusion, equitable quality education and lifelong learning opportunities for all, particularly marginalized or vulnerable groups [25].

In the context of MOOCs, research has explored specific strategies for mitigating stereotype threat. Kizilcec and Saltarelli [14] introduced the concept of "psychologically inclusive design," which involves modifying visual, textual, and interactive elements to minimize identity-based pressures. Experimental studies demonstrate that inclusive design features—such as diverse imagery and supportive feedback—can enhance learners' sense of belonging and persistence in online courses [17, 20]. Other studies emphasize the importance of adaptive technologies that tailor content to learners' backgrounds and needs, improving engagement and reducing dropout rates [21, 36]. Despite these advances, existing literature often evaluates interventions in isolation, lacking a comprehensive perspective on how various strategies interact to address stereotype threat across diverse educational contexts. This fragmentation limits our ability to design MOOCs that systematically promote equity and inclusion. By synthesizing insights from previous research, this study seeks to bridge these gaps and provide actionable recommendations for inclusive MOOC design as well as future directions.

3 Research approach

To address RQ1, we conducted a systematic literature review [38, 39]. Previously, we scanned some of the most salient articles in the field to determine the search term. Using the ISI Web of Science database as a starting point, we extended our search to IEEE, AISeL, ScienceDirect, Wiley, ACM Digital Library, EBSCOhost, Scopus, JSTOR, as well as SpringerLink and Google Scholar, to ensure comprehensive coverage. The search was conducted from October to December 2022. It included all articles up to that time, without any prior time restriction, to capture a comprehensive view of the established research trends of recent years. The search query was developed iteratively based on RQ1 to identify literature on online learning and stereotype threat. The corresponding search term was as follows: ("e*learn*" OR "digital learn*" OR "online learn*" OR "online course*" OR "smart education" OR "digital educat*" OR "Massive Open Online Course*" OR "MOOC*" OR "virtual learn*" OR "distance learn*" OR "web-based learn*" AND "stereotype threat*"). This query was iteratively refined through preliminary testing to maximize relevance. Incorporating truncation into the search term for several scholars ensured that variations of words were included, maximizing the retrieval of relevant literature. Terms like "inclusive design solution" were excluded to avoid filtering out articles that indirectly addressed this theme. Instead, insights into inclusive design were evaluated during the full-text screening phase.

Following vom Brocke et al. [40], we structured the review using Cooper's taxonomy [41] focusing on categories such as goals, coverage, and organization. These guided our methodological framework (Table 1).

Focus determines the material that is of primary interest for the literature review. Since our literature review aims to identify essential design elements for inclusive MOOCs, we focused on research outcomes. *Goal* defines what the study should accomplish. In the case of our review, the goal is to identify and synthesize the central issues of the domain. *Perspective* concerns the reviewer's point of view. Since our review attempts to not only represent the value of a particular point of view but also aggregate the literature findings, we consider the perspective of our review neutral. *Coverage* defines how reviewers search the literature, and which articles are included in their review. Since we reviewed the literature from multiple databases, focusing on those deemed relevant, we consider our literature review exhaustive with selective citation. *Organization* describes how the literature review combines the reviewed articles. In this case, we connected them conceptually so that articles with the same abstract ideas appear together. Finally, *audience* describes

Table 1 Conceptualization of the systematic literature review following the taxonomy of cooper

<table>
<tr><th></th><th>Characteristics</th><th colspan="12">Categories</th></tr>
<tr><td>(1)</td><td>Focus</td><td colspan="3">Research Outcomes</td><td colspan="3">Research Methods</td><td colspan="3">Theory</td><td colspan="3">Practices or Applications</td></tr>
<tr><td>(2)</td><td>Goal</td><td colspan="4">Integration</td><td colspan="4">Criticism</td><td colspan="4">Identification of Central Issues</td></tr>
<tr><td>(3)</td><td>Perspective</td><td colspan="6">Neutral Representation</td><td colspan="6">Espousal of Position</td></tr>
<tr><td>(4)</td><td>Coverage</td><td colspan="3">Exhaustive</td><td colspan="3">Exhaustive with Selective Citation</td><td colspan="3">Representative</td><td colspan="3">Central or Pivotal</td></tr>
<tr><td>(5)</td><td>Organization</td><td colspan="4">Historical</td><td colspan="4">Conceptual</td><td colspan="4">Methodological</td></tr>
<tr><td>(6)</td><td>Audience</td><td colspan="3">Specialized Scholars</td><td colspan="3">General Scholars</td><td colspan="3">Practicioners or Policy Makers</td><td colspan="3">General Public</td></tr>
</table>

the review's intended audience. We address an audience of general scientific scholars and practitioners as we provide practical implications and future research avenues.

The systematic search process identified an initial pool of 1260 articles. To ensure rigor and accuracy, we employed automated and manual deduplication methods, removing 87 duplicates and leaving 1173 unique articles for further evaluation.

Step 1 (Title Screening): The titles of the remaining articles were reviewed to identify studies relevant to inclusivity for underrepresented groups facing stereotype threat in the context of online learning. This step resulted in the exclusion of 793 articles deemed outside the study's scope.

Step 2 (Abstract Screening): The abstracts of the remaining 380 articles were assessed for relevance. At this stage, 73 additional articles were excluded based on their lack of alignment with the research focus, leaving 307 articles for full-text analysis.

Step 3 (Full-Text Screening): The full texts of these 307 articles were analyzed using the following inclusion criteria:

- The study must address the context of online learning with direct applicability to MOOCs.
- It must focus on at least one underrepresented group experiencing stereotype threat.
- It must provide insights into inclusive design, particularly inclusive design solutions.

Based on these criteria, 59 articles were selected for detailed analysis. These papers were imported into MAXQDA[1] for comprehensive coding and synthesis to extract insights for fostering inclusivity in MOOCs. Figure 1 illustrates each step of the systematic search process in a PRISMA flow diagram.

We used a methodical approach to organize the information from the paper analysis, employing content and thematic analysis techniques [42]. Data was categorized based on the research question, with significant excerpts identified through an initial review [43, 44]. MAXQDA facilitated thematic analysis, enabling the identification of recurring patterns and themes relevant to inclusive MOOC design. The coding process involved iterative collaboration among three researchers to ensure objectivity. Each researcher independently developed codes, which were refined through joint workshops. This iterative process resulted in a coherent coding system, leading to a coding structure containing two overarching themes categorized as *success indicators* and *inclusive design solutions*. To these themes, different categories with its characteristics could be assigned (Table 2). All elements of the coding system are described in Sect. 4.

Additionally, a bibliometric analysis of the final 59 articles was conducted [45], to support the research agenda developed for RQ2, as discussed in Sect. 5.

[1] MAXQDA: https://www.maxqda.de.

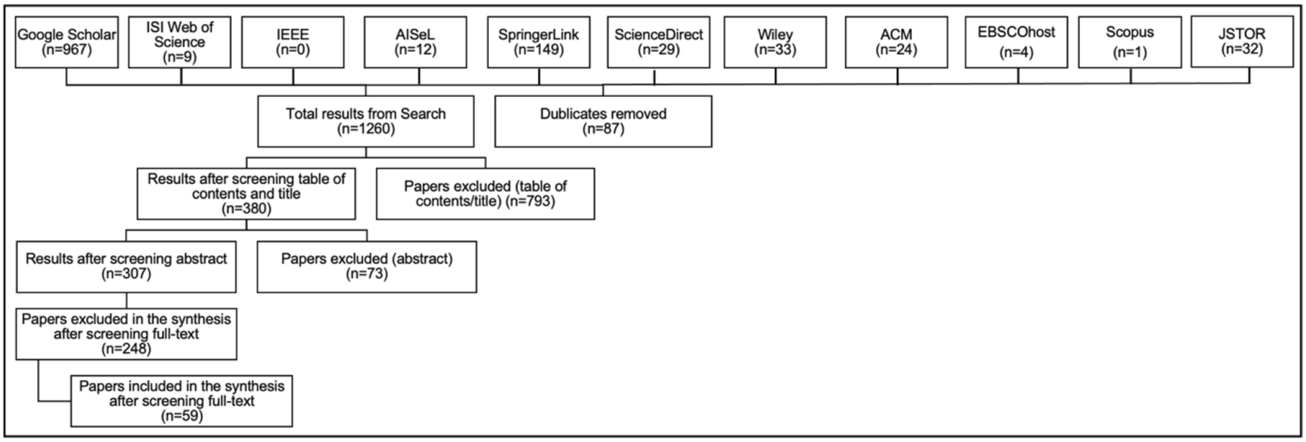


Fig. 1 Systematic search process

4 Findings (RQ1)

4.1 Success indicators

The literature identifies three key categories of indicators for measuring inclusive teaching success: *participation, psychological,* and *performance indicators*. By analyzing these indicators, educators can refine inclusive online learning strategies such as in MOOCs.

Participation indicators measure learners' engagement in activities, focusing on mentoring and community support. *Mentoring.* Mentoring emerges as a crucial participation indicator, particularly for underrepresented groups such as women, older adults, and people of color, who often encounter stereotype threats in their educational and professional trajectories. Inclusion in diverse learning and professional teams is associated with increased engagement and retention, fostering equity and reducing turnover. Close mentorship relationships, especially those aligned with learners' interests and challenges, significantly enhance participation and learning outcomes [82]. E-mentoring, where learners interact with more knowledgeable individuals in a digital environment, exemplifies this principle and provides a scalable way to support underrepresented groups [60, 62]. *Community Support.* Community support reflects the degree to which individuals receive and contribute to social and collaborative interactions within a learning environment [77]. Research highlights that robust social support networks, particularly in collaborative contexts, are pivotal for the success of underrepresented groups [61, 77, 84]. For instance, Brooks et al. [52] demonstrated that increased female participation in MOOCs correlates with higher overall course engagement and discussion activity, although the effects on male learners may differ slightly. Additionally, cultivating an atmosphere of community support and collaboration can significantly enhance learner participation and overall success.

Psychological indicators evaluate the mental and emotional factors contributing to a learner's success. These include measures of learners' sense of belonging, awareness, motivation, and overall well-being. These indicators focus on how effectively an educational environment supports learners in overcoming internal and external barriers, such as stereotype threat or feelings of isolation, to maintain engagement and achieve success. *Sense of Belonging.* A sense of belonging is pivotal for learners' motivation and success in online environments [89, 97]. Kizilcec et al. [69] assert that belonging is closely linked to perceptions of social identity and fit within a context. When entering a new environment, individuals often ask themselves a simple yet consequential question about the perceived fit between the self and a context: "Do I belong here?" Interventions aimed at fostering a resilient sense of belonging—such as connecting learners with peers or aligning the learning content with learners' identities—have proven effective [73, 93]. Additionally, addressing "ambient belonging" [53], the sense of connection to one's surroundings, is critical in combating stereotype threat, particularly in environments with implicit biases. For instance, it was shown that women felt significantly lower ambient belonging in the stereotypical informatics classroom, which could negatively affect their learning success [53, 54]. Such examples highlight that community integration plays a significant role [77]. *Awareness.* Building awareness by actively promoting mindset shifts among both learners and instructors is crucial. This involves increasing awareness of stereotypes in online classrooms and providing personal affirmation

Table 2 Concept matrix on success indicators and inclusive design solutions for fostering inclusivity in MOOCs

Authors	Sum of occurences	Coding system								
		Success indicators			Inclusive design solutions					
		Participation indicators	Psychological indicators	Performance indicators	Personali-zation	Anonymity	Mindset change	Role models	Stereotyped vs. balanced design	Support
AlSulaiman and Horn [46]	1								x	
Arroyo et al. [47]	2		x							x
Baylor and Plant [48]	1									x
Beege et al. [20]	1									x
Beins [49]	2		x							x
Bosch et al. [50]	1						x			
Bracken and Wood [51]	2		x					x		
Brooks et al. [52]	5	x	x	x	x				x	
Cheryan et al. [53]	3		x	x					x	
Cheryan et al. [54]	3		x	x					x	
Cheryan et al. [55]	3		x	x					x	
Cohen and Sherman [56]	2		x					x		
Crues et al. [11]	3	x		x						x
Darling-Aduana [57]	1									x
Ensher and Murphy [58]	1							x		
Good et al. [59]	1				x					
Gregg et al. [60]	2	x						x		
Halawa et al. [61]	4	x	x	x						x
Harris et al. [34]	7	x			x	x	x	x	x	x
Huderson et al. [62]	5	x	x				x	x		x
Huffman et al. [63]	4		x				x	x	x	
Jay et al. [35]	2					x				x
Kerkhofen et al. [64]	4		x				x	x	x	
Kim and Lim [65]	1									x
Kizilcec and Halawa [66]	2		x				x			
Kizilcec and Saltarelli [67]	3		x				x		x	
Kizilcec and Saltarelli [14]	3		x				x		x	
Kizilcec, Davis, et al. [68]	2		x				x			
Kizilcec, Saltarelli, et al. [12]	1									x
Kizilcec et al. [69]	5		x		x			x	x	x
Korlat et al. [70]	1									x
Krämer et al. [21]	3		x					x		x
Le Hénaff et al. [71]	1					x				

Table 2 (continued)

Authors	Sum of occurences	Coding system								
		Success indicators			Inclusive design solutions					
		Participation indicators	Psychological indicators	Performance indicators	Personali-zation	Anonymity	Mindset change	Role models	Stereotyped vs. balanced design	Support
Lee et al. [72]	3		x		x		x			
Leider and Strobel [73]	5		x	x		x	x			x
Moreno and Flowerday [74]	1									x
Rai and Simpson [75]	4		x				x		x	x
Richard [76]	1							x		
Richard and Hoadley [77]	4	x	x					x		x
Roessler and Allison [78]	1				x					
Rosenberg-Kima et al. [79]	3		x					x		x
Sanga et al. [80]	3						x	x		x
Schöbel et al. [19]	1									x
Sparks and Pole [81]	2		x				x			
Stelter et al. [82]	6	x	x	x			x	x		x
Stoeger et al. [83]	1							x		
Sullivan et al. [84]	2	x								x
Svedin and Bälter [85]	4			x			x	x		x
Toda et al. [86]	1				x					
Todd et al. [87]	3		x	x				x		
de Waard et al. [88]	2		x				x			
Walton and Brady [89]	1		x							
Walton and Cohen [90]	2		x				x			
Weinhardt and Sitzmann [91]	2				x		x			
Wolfson et al. [92]	2				x		x			
Yeager et al. [93]	2		x				x			
Yao and Boss [94]	1					x				
Yeboah and Smith [95]	3			x	x					x
Ypma [96]	4				x		x		x	x

Grey shading denotes the taxonomy categories within each characteristic that have been operationalized in this review. Unshaded cells indicate categories that were not applied. Detailed descriptions of each operationalized category follow in the text to students [56]. Research has shown that stereotype threat can impact students' performance, especially in environments dominated by a different gender [52, 54]. Therefore, more awareness should be built of this phenomenon to catalyze positive change in learners' and instructors' perceptions. *Motivation.* Motivation is integral to learner success. As Leider and Strobel [73] emphasize, learners who feel connected to their peers and develop a positive group identity exhibit higher motivation and therefore, persistence. Conversely, a lack of interventions to foster motivation (such as providing feedback, recognition, and a sense of progress), particularly in STEM fields, disproportionately affects marginalized students. *Well-being.* Overall well-being is measured as a psychological indicator contributing to a learner's success [75]. In a world where technology is omnipresent, the question emerges of how it can enhance well-being and foster human eudaimonia. Eudaimonia refers to realizing one's potential, encompassing a sense of fulfillment, long-term significance, positive affect, and meaningfulness [37, 98, 99].

Performance indicators assess the tangible outcomes of a learning experience, including academic achievements, skill acquisition, and persistence. These indicators often involve metrics such as grades, test scores, or the ability to meet predefined learning objectives. Performance indicators also account for external factors, such as flexibility, time convenience, language barriers, and the inclusivity of the learning environment, which can influence these outcomes. *Academic Achievement.* Academic achievement reflects measurable outcomes such as grades, test scores, or certifications attained through a learning process. It serves as a direct measure of the knowledge and competencies acquired in a course or program and indicates how well learners meet the educational objectives. *Skill Acquisition.* This pertains to the development of specific abilities or expertise through learning experiences. It involves gaining practical or theoretical skills that enhance learners' capabilities in a particular domain, demonstrating their ability to apply knowledge effectively in real-world or academic contexts. *Persistence.* Persistence measures a learner's ability to remain engaged and committed to completing a course or program despite challenges or obstacles. High persistence rates indicate strong learner motivation and the capacity to overcome barriers, which is critical for long-term success in educational settings [61, 95]. These indicators are influenced by several external factors. According to Yeboah and Smith [95], learning performance is interdependent with the use of technology, number of online courses, and program of study in online learning. Further influencing factors emerged in their study, such as flexibility and time convenience, self-confidence, lack of support, self-regulated learning skills, and language. Linguistic differences or the inclusivity of the prevailing course environment are also influencing factors [54].

4.2 Inclusive design solutions

The analysis has identified six specific categories of inclusive design solutions for MOOCs. These are: *personalization, anonymity, mindset change, role models, stereotyped vs. balanced design*, and *support*. By integrating these inclusive design solutions, MOOCs have the potential not only to mitigate the impact of stereotype threat but also to foster greater participation, engagement, and success among underrepresented groups in education. These are presented in detail in the following.

Personalization: providing personalized learning content. In the context of MOOCs, personalization assumes a pivotal role within the broader framework of inclusive design [72]. The attributes of various design elements must be adjusted and personalized depending on whether the participant in an online course belongs to a marginalized group. Such elements include the language utilized in the course [59], the potential access points to the provided learning materials [34], the gender ratio of the course participants [96], the pace and flexibility of the course [95], and the social form in which the task is performed [86]. One method for achieving personalization is to provide learners with control over the attributes of the course design elements. Secondly, personalization can be achieved through the implementation of data-driven solutions. In this approach, the learning environment is automatically adjusted based on the learner's user models to provide optimal support for learner success [52]. MOOCs are well-suited to the implementation of automated personalization in a rapid and cost-effective manner, with the use of AI algorithms as a potential solution.

Anonymity: The possibility to remain anonymous in the learning process. MOOCs provide learners with the opportunity to engage in learning activities within a fully or semi-anonymous environment. In such a setting, learners can participate in a way that allows them to be seen more objectively, without their appearance influencing their interactions. The anonymity factor enables learners to engage in learning activities without worrying about how they are perceived in a physical classroom setting [73]. Consequently, it offers minorities the chance to rebuild their self-assurance, which they may lack in personal interactions. In such interactions, they may experience a sense of discomfort and marginalization, given that within the physical classroom, they are more likely to perceive and internalize social differences. In an anonymous online setting, minority students who are confronted with stereotype threat may be particularly inclined to engage in open communication and information sharing, as they perceive a greater sense of safety behind their keyboards [94].

Moreover, as Le Hénaff et al. [71] have observed, anonymity affects social behavior by underscoring the significance of group identity and reducing interpersonal differences, which in turn fosters stronger group identification and a greater motivation to work for the benefit of one's group. Moreover, anonymous online communication, facilitated by forums and chat platforms, can enhance the diversity of participation and mitigate learners' anxiety. It enables participants to inquire without the awareness of their peers or to present responses anonymously [34]. Consequently, obstacles to help-seeking may be diminished in online courses that offer heightened anonymity and a normalized avenue for requesting assistance [35].

Mindset Change: Creating encouraging learning environments. The shift of the mindset of both teachers and students within the context of MOOCs necessitates the implementation of a multifaceted approach. Such strategies include raising awareness of stereotypes in online courses, offering personal affirmation to students, and strengthening their sense of belonging. It is incumbent upon educators to engage in introspective reflection regarding their own biases and to identify instances where stereotypes may exert an influence on students. Psychological surveys and discussions with peers in virtual forums can facilitate this process [34]. Similarly, students should be educated about stereotypes and bias, thereby empowering them to navigate challenges they may encounter [96]. The inclusion of diversity statements in MOOCs within the STEM field has been demonstrated to enhance awareness of inequality and influence the enrollment patterns of underrepresented sociodemographic groups [67]. Furthermore, personal affirmations are of great importance in combating stereotype threat. The identification of students' strengths and the encouragement of self-expression have been demonstrated to enhance their self-esteem while they develop new competencies [73, 88, 92]. Kizilcec and Saltarelli [68] also discuss value-relevant affirmations, which are designed to reinforce a person's self-concept and safeguard them from threats to their sense of belonging and social identity by affirming the relevance of their own values, abilities, or identity for learner engagement and success. Moreover, it is crucial to cultivate a sense of belonging. Teachers can facilitate connections between students and foster a sense of community using online forums [73]. Incorporating affirmations and diversity statements into the course description and throughout the course can serve to reinforce inclusivity [67, 73]. In addition, instructors must exercise caution to ensure that their pedagogical approaches do not inadvertently perpetuate stereotype threat. It is beneficial for them to receive education regarding stereotype threat, as this can assist them in effectively navigating their biases and stereotypes.

Role models: Providing role models that faced similar threats. In the context of MOOCs, the provision of role models who have confronted comparable challenges can serve as an efficacious, inclusive solution. The presence of supportive communities within MOOCs can help mitigate the impact of stereotype threat by providing access to a diverse range of role models and establishing an environment that is conducive to understanding and managing bias. Such communities, which may be characterized as resilience-oriented, can provide support to a variety of marginalized groups [76]. For example, research indicates that Black women in STEM fields benefit from forming communities with other Black women who serve as role models, which leads to an increased sense of belonging [62]. Inclusive teaching within MOOCs can also benefit from e-mentoring, which is a crucial element in providing role models and support. E-mentoring is a mutually beneficial relationship between an underrepresented mentee and a mentor (either adult or peer). The benefits of e-mentoring include enhancing interest, cultivating belonging, boosting self-efficacy, providing feedback, and promoting resilience [82, 87]. Communication between the mentee and mentor, as well as other participants, occurs through various online platforms, including email, chat, instant messaging, video, and forums, ensuring constant access to the course environment [60, 83]. E-mentoring is especially advantageous for minority groups, such as women and individuals of color, as it can help to overcome initial impression barriers based on appearance [62, 83]. The success of e-mentoring programs hinges on the efficacy of the mentor–mentee matching process [58]. Another valuable approach is the utilization of same-age or near-age peer mentors, as evidenced by recent research [82].

Stereotyped vs. balanced design: Using stereotype cues to avoid stereotype threat. The use of stereotypical cues can profoundly influence the attractiveness and effectiveness of online courses for underrepresented groups facing stereotype threat. Kizilcec and Saltarelli [14] differentiate between verbal and visual cues, both of which can shape learners' perceptions and experiences in significant ways.

Verbal cues involve language choices that may either reinforce or mitigate stereotype threat. For instance, the use of masculine pronouns when referring to both genders [64] or incorporating stereotypically male examples (e.g., dragons, the galaxy) in computer science content [100] alienate learners from underrepresented groups. These cues can subtly threaten learners' identities. Furthermore, Huffmann et al. [63] found that using examples traditionally associated with women in technology contexts can enhance comfort and identification with the content, potentially mitigating stereotype threat for female learners.

Visual cues can also significantly impact learners. Kizilcec and Saltarelli [14] classify these into two main categories: *visual design cues* and *visual content cues*. *Visual design cues* refer to the overall appearance of the online learning environment. Research by Cheryan et al. [54] suggests that non-stereotypical visual cues—such as nature posters instead of typical masculine imagery like video games—can increase female students' interest in fields such as computer science. On the other hand, *visual content cues* refer to specific visual elements that convey information or evoke responses from viewers and can unintentionally perpetuate stereotypical norms.

The frequency of representation of underrepresented groups, along with the roles in which they are depicted, is also a critical factor. Depictions of under- or overrepresented groups in stereotypical or counter-stereotypical roles may also reinforce stereotype threat. One approach to addressing this issue is using *neutral visual cues*. This design strategy involves balancing masculine and feminine attributes in the visual environment, using a range of examples, colors, and shapes to create a non-stereotypical learning atmosphere. Cheryan et al. [54] demonstrated that such neutral visual designs can increase female learners' sense of belonging in computer science courses. Alternatively, *stereotype-balanced* or more *diverse visual designs* that incorporate a broader range of representation—reflecting gender, race, and other diversity factors—are proposed by AlSulaiman and Horn [46]. They argue that a diverse approach, as opposed to strictly neutral designs, better reflects the diversity of learners and fosters a more inclusive environment. While neutral cues may be effective, limiting the design to a binary or narrowly defined space may restrict the potential to address the varied needs of all learners.

Given the customizable nature of MOOCs, both verbal and visual cues can be adjusted to suit participants' needs. However, the effectiveness of different approaches—whether stereotype-balanced, stereotype-neutral, or stereotype-specific—remains a subject of ongoing debate.

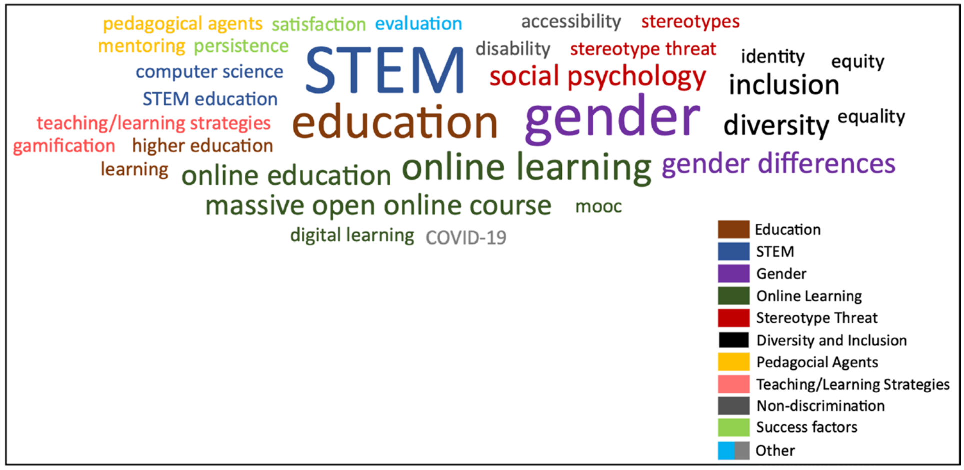
Support: Providing low-threshold opportunities to ask for help. Support as an inclusive design solution in MOOCs encompasses a range of strategies aimed at creating an inclusive, supportive learning environment. These strategies include building supportive communities, implementing pair programming methods, providing low-threshold support opportunities (e.g., anonymous chats or structured forums), and utilizing conversational agents (CAs) or informal communication methods. These approaches protect underrepresented groups and foster resilience [77].

When it comes to supportive communities and low-threshold opportunities, Harris et al. and Jay et al. [34, 35] highlight that tools allowing students to ask questions anonymously—through chats or forums—can alleviate anxiety and encourage more diverse participation. Additionally, structured forums have been shown to contribute to the trust and cohesion of groups, and their use has been associated with greater overall engagement in online courses [61]. These forums have been shown to particularly benefit women, increasing their participation and persistence in online learning environments [11, 95]. Crues et al. [11] found that women who participated more frequently in forums were more likely to persist in their studies compared to those who did not, a trend that also applied to male learners.

CAs, which provide opportunities for students to ask for help without direct interaction with an instructor, also play a significant role in promoting inclusivity. Studies like Krämer et al., Arroyo et al. and Kim and Lim [21, 47, 65] have emphasized the importance of agent-based technologies in fostering socially rich learning environments. Customizing CAs to meet the needs of specific demographic groups can enhance personalized learning experiences [19, 20]. Research indicates that agents that match learners' characteristics, such as race, gender, or age, can boost self-efficacy and engagement, particularly for women [79]. Baylor and Plant [48] found that women preferred agents with whom they could identify, while Arroyo et al. and Krämer et al. [21, 47] challenged the assumption that same-gender agents are always more effective, arguing that opposite-gender agents can improve performance when a connection is established, such as shared interests or mutual understanding. Moreover, Moreno and Flowerday [74] found that students of color preferred agents of the same ethnicity rather than the same gender, an observation further supported by Darling-Aduana [57], who highlighted the positive impact of same-race or -ethnicity instructors on marginalized students. Schöbel et al. and Krämer et al. [19, 21] advocate for tailored solutions to cater to different demographic groups, emphasizing that personalized CA features can significantly enhance learning experiences. Beege et al. [20] also suggest aligning CAs with specific life stages to improve learning outcomes, such as using young voices in educational videos for younger learners.

It is also evidenced that informal communication methods, such as fostering social presence and intimacy through personal expression, humor, and experience-sharing, are of great importance for the development of a supportive community and the reduction of psychological and social distance in MOOCs [49].

Fig. 2 Emerging keyword groups from the word cloud of the bibliometric analysis



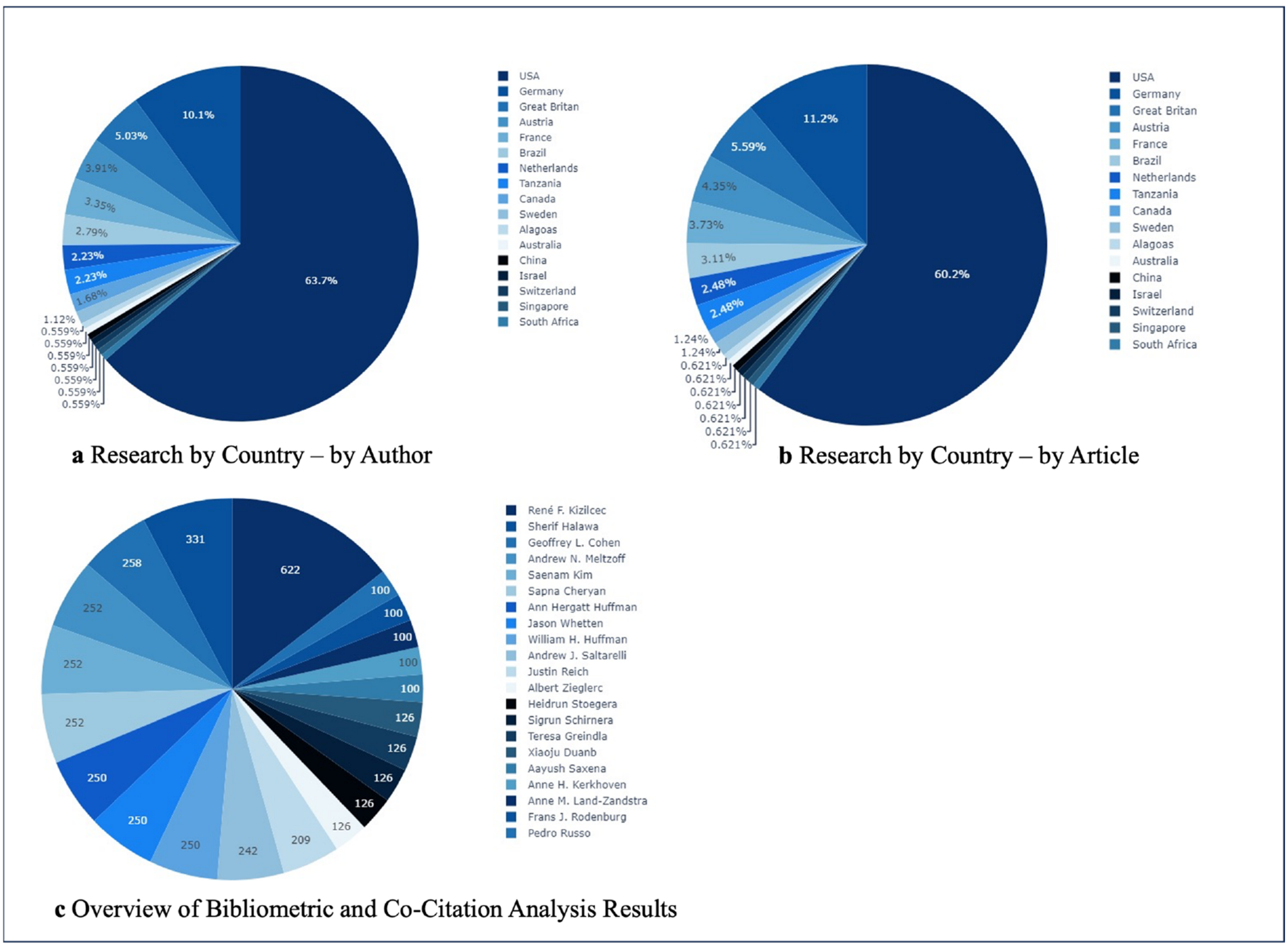


Fig. 3 Distribution of analyzed papers by authors and country of publication

5 Research gaps and agenda (RQ2)

To address RQ2, a bibliometric analysis of 59 articles (Figs. 2 and 3) was conducted, research methods were examined (Fig. 4), and the co-occurrence of success indicators and inclusive design solutions was analyzed (Fig. 5). By adopting

Research Methods / Coding System		Success Indicators			Inclusive Design Solutions					
		Participation Indicators	Psychological Indicators	Performance Indicators	Stereotyped vs. Balanced Design	Personalization	Anonymity	Mindset Change	Role Models	Support
Quantitative	Experiment	1	12	5	7	2	1	6	5	8
	Digital Trace Data	1	1	1	1	0	0	2	0	2
	Archival Research	0	1	0	1	0	0	2	2	1
	Survey	2	5	2	2	4	0	3	4	8
Literature Review	Literature Review	3	7	1	0	5	2	9	7	5
Qualitative	Interview	2	2	0	2	2	1	3	3	4
	Survey	2	3	2	1	3	0	2	1	4
	Case Study	0	1	0	1	2	1	1	1	0
	Observation	2	1	1	0	0	1	1	2	5
	Focus Group	1	1	0	0	0	0	1	0	1

Fig. 4 Applied research methods for examining inclusive design solutions and their success indicators

this approach, critical research gaps are systematically identified, and promising directions are derived for advancing the field.

The findings highlight a growing research interest in stereotype threat and inclusive design within online learning, particularly in MOOCs, emphasizing the need to support diverse and underrepresented learners. Keyword analysis strongly emphasizes STEM disciplines and gender-related challenges (Fig. 2),[2] reflecting a predominant effort to encourage women's participation in traditionally male-dominated fields like STEM.

[2] The different colors of the keywords in the word cloud represent the different keyword groups into which they were clustered by two researchers, as shown in the legend on the right.

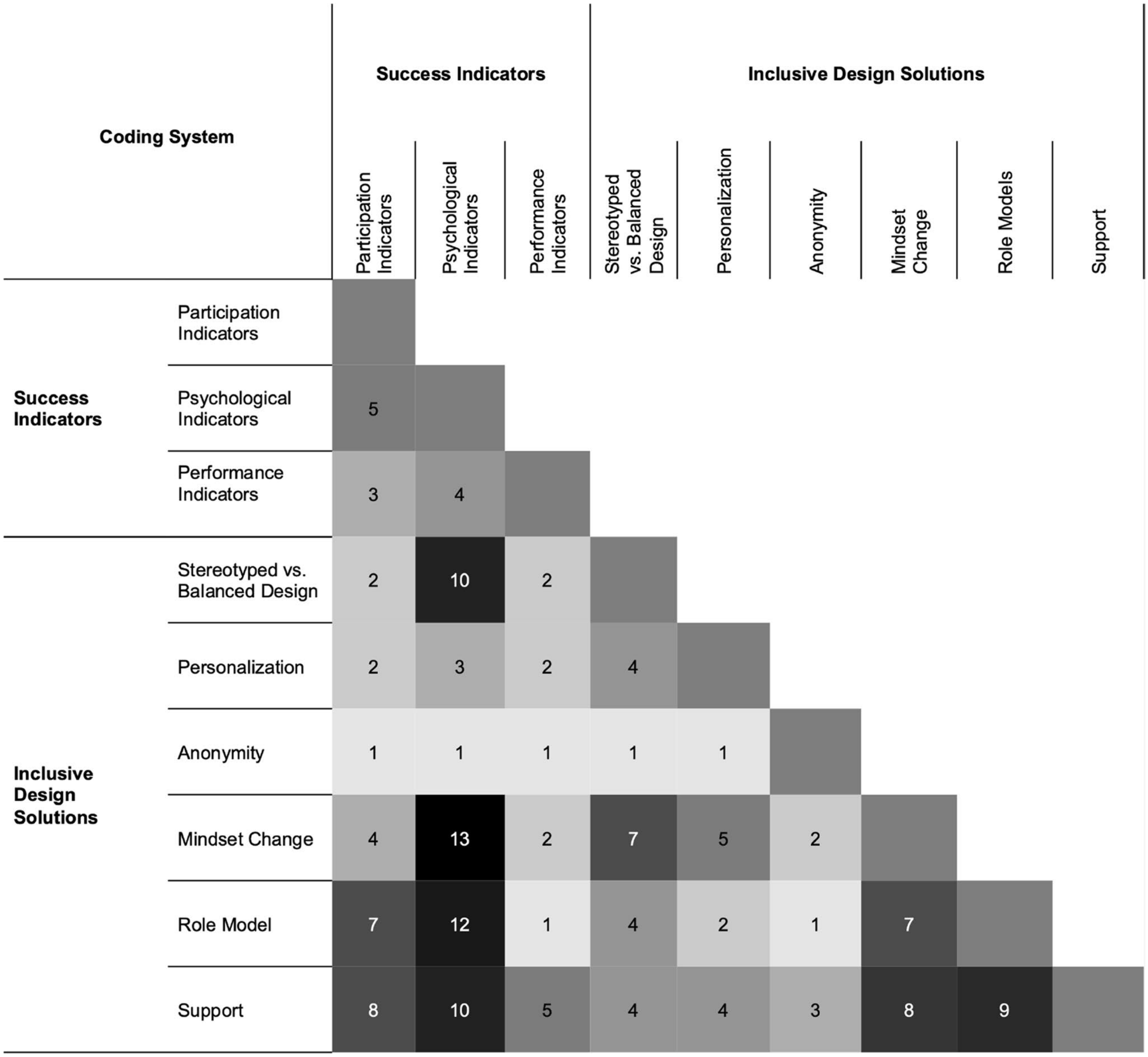


Fig. 5 Co-occurrence of success indicators and inclusive design solutions

Other prominent keyword clusters include terms such as education, online learning, stereotype threat, diversity and inclusion, pedagogical agents, teaching and learning strategies, non-discrimination, and success factors.

A detailed analysis of metadata reveals geographic trends, showing that most studies on stereotype threat and the inclusive design of MOOCs originate from the United States, followed by Germany and the United Kingdom (Fig. 3a and b). These figures distinguish author contributions (Fig. 3a)[3] and article-level contributions (Fig. 3b). Notably, key contributors to the broader research field include Kizilcec, Halawa, and Cohen (Fig. 3c).

Figure 4 illustrates the prevalence of different research methods applied to study inclusive design solutions and success indicators in MOOCs. The figure employs color coding to represent methodological approaches: shades of blue indicate quantitative studies, red represents qualitative studies, and gray represents literature reviews. Within each color, lighter shades signify lower occurrence, while darker shades indicate higher occurrence in the literature.

[3] If more than one author of an article is from the same country, the article will still be counted only once for that country. If there are several different countries of origin, each country is counted once per article.

The research methods employed in the field are diverse, encompassing experiments, digital trace data, archival research, surveys, literature reviews, interviews, case studies, observations, and focus groups—overall, most studies are quantitative. Most frequently studied inclusive design solutions include *support, mindset change*, and *role models*. However, some solutions remain underexplored. For instance, only six of the 59 papers examine *anonymity* as a design solution, highlighting a critical area requiring further exploration to understand its potential to benefit underrepresented learners. Similarly, while *role models* are frequently studied, research predominantly employs quantitative methodologies, such as statistical analyses, to measure their impact. Qualitative surveys, case studies, observations and focus groups remain underexplored. Qualitative approaches such as focus groups or interviews could provide richer insights by exploring learners' subjective experiences and the intricate dynamics of their interactions with role models. For example, qualitative research could uncover how role models influence learners' sense of belonging, motivation, and awareness, offering a deeper understanding of the mechanisms that contribute to the success of this design solution.

Figure 5 illustrates the co-occurrence of success indicators and inclusive design solutions in the literature. As in Fig. 4, varying color shades represent differing levels of representation in the literature.

The analysis highlights that most studies examining inclusive MOOC design emphasize *psychological success indicators*. This trend aligns with the interdisciplinary applications of information technology and psychology, which extend to web applications, apps, games, human resources, social marketing, and consumer research. Studies focusing on psychological indicators frequently investigate inclusive design solutions such as *mindset change, role models*, and *support*.

However, notable gaps persist in the literature. For instance, the relationships between psychological indicators and solutions like *anonymity* and *personalization* remain underexplored. Similarly, while *participation indicators* are commonly employed to evaluate *support solutions*, the use of *performance indicators* is relatively rare. This scarcity presents a critical gap, as performance-based research is essential to understanding how inclusive design solutions impact learners' measurable achievements in MOOCs.

Inclusive design solutions such as *stereotyped vs. balanced design, personalization, anonymity, mindset change*, and *role models* merit further evaluation concerning performance indicators. A promising avenue for future research involves leveraging digital trace data from e-learning platforms to assess the effectiveness of these solutions. By systematically evaluating platforms against the six specific inclusive design solutions, researchers can gain insights into their impact on diversity and learning outcomes. Such an approach would enable robust comparative analyses of design interventions' effectiveness across diverse learner populations.

In summary, while progress has been made in understanding success indicators and inclusive design solutions, significant potential remains untapped, particularly regarding performance-based outcomes. Addressing these unexplored dimensions will be instrumental in advancing equitable and engaging MOOCs.

To synthesize these insights, Table 3 outlines key research gaps and proposes a future research agenda. Four main gaps are identified: *"Single Solution Gap," "Overarching Solution Gap," "Success Indicators Gap,"* and *"Social Impact Gap*.

6 Discussion

6.1 Key findings

The following presents the key findings.

Success Indicators: Three key categories of success indicators are identified for evaluating inclusive teaching in MOOCs: participation, psychological, and performance indicators. *Participation indicators* assess learners' engagement in collaborative or community-based activities, such as mentoring or community support. *Psychological indicators* focus on emotional and mental factors, including a sense of belonging, awareness, motivation, and well-being to overcome barriers like stereotype threat. *Performance indicators* evaluate tangible outcomes, such as academic achievements, skill acquisition, and persistence, while considering external factors like flexibility, language barriers, and inclusivity. Together, these indicators offer educators and designers a framework to identify areas for improvement and tailor inclusive strategies to mitigate stereotype threat and foster equity in education.

Inclusive design solutions: Six specific inclusive design solutions are categorized to mitigate stereotype threat and create equitable learning environments in MOOCs: *Personalization* involves tailoring the learning experience to individual learners, which has been shown to enhance engagement and performance**.** *Anonymity* enables learners to remain unidentified during the learning process, thereby reducing the impact of stereotypes based on their appearance or identity. This fosters confidence and encourages participation**.** *Mindset Change:* Creating encouraging learning environments that

Table 3 A research agenda to promote inclusiveness in MOOCs

Research gaps	Deficiencies in research	Proposed research questions	Proposed research methods	Reference (this article)
The single solution gap	Research gaps emerge within single inclusive design solutions. These include lack of research on the impact of anonymity in online learning on the performance of underrepresented groups. Additionally, there is not yet a consensus on whether stereotyped or balanced design options better promote the learning performance of under- and overrepresented groups	How does anonymity in online learning environments such as MOOCs affect the learning performance of underrepresented groups?	Experiment	Sections 4.1, 4.2 and 5; Fig. 4
		How do stereotyped or balanced cues in online learning affect the learning performance of under- and overrepresented groups?	Experiment	
		How do stereotyped or balanced support options affect the learning performance of under- and overrepresented groups?	Experiment	
The overarching solution gap	Prior research has focused primarily on the investigation of single design solutions and has not yet integrated them into an overarching model	What inclusive design solution has the most significant impact on the learning performance of under- and overrepresented groups?	Experiment, Digital Trace Data, Meta-Analysis	Sections 1, 4.2 and 5
		What moderating effects do the inclusive design solutions have on each other?	Framework Development	
		How can inclusive design solutions be transferred into design principles and design requirements to use them to evaluate existing MOOCs in this area?	Design Science Research, Prototyping	
		Which other inclusive design solutions are identifiable in practice?	Expert Interviews, Market Analysis	
The success indicators gap	Previous research has not yet evaluated the identified inclusive design solutions against every success indicator. Furthermore, the three indicators have not yet been integrated into an overarching theoretical model	Which inclusive design solution has the most significant impact on each success indicator?	Experiment	Section 5; Figs. 4 and 5
		How do the success indicators relate to each other?	Framework Development	
		Which other success indicators are available to evaluate inclusive design solutions?	Expert Interviews, Case Studies	
The social impact gap	Over time, the increasing number of publications shows that research on stereotype threat and inclusive online learning is also increasing. The keywords in the analyzed papers strongly focus on STEM and gender. This indicates previous research has been concerned with motivating females to engage in male domains instead encouraging males to participate in female ones	Why does research not focus on motivating men to engage in stereotypically female domains to overcome gender (pay) gaps?	Expert Interviews	Section 5; Fig. 2
		How does research on the inclusive design of MOOCs impact social development?	Expert Interviews, Archival Research	

raise awareness of biases, promote self-affirmation, and strengthen belonging can significantly reduce stereotype threat. *Role Models:* Featuring underrepresented role models motivates learners and provides relatable success stories through e-mentoring or supportive communities. *Stereotyped vs. Balanced Design* involves strategically choosing design elements, such as texts or images, to either challenge or neutralize stereotypical cues. This thoughtful placement of content can help avoid reinforcing negative stereotypes. *Support:* Offering accessible help through community engagement, forums, CAs, and informal communication reduces barriers for minorities in MOOCs. These solutions, when integrated into MOOCs, can enhance participation, engagement, and success among underrepresented groups, addressing stereotype threat and systemic inequalities in education.

Research Agenda: Four significant gaps are identified with proposed steps to address them in future research: *The Single Solution Gap.* Research has yet to reach a consensus on certain inclusive design solutions, such as whether learning environments should be stereotyped or balanced. Furthermore, experimental evaluations of each solution are needed. *The Overarching Solution Gap.* Most studies examine solutions in isolation. Future research should integrate multiple solutions into cohesive frameworks and test their interactions using controlled experiments or MOOC data. This approach could translate findings into actionable design principles to improve existing MOOCs. Design science research and prototyping can support the development of automated tools integrating these solutions, while practice-oriented studies, such as expert interviews and market analyses, may reveal additional approaches. *The Success Indicators Gap.* The interaction between success indicators and design solutions remains underexplored. Future work should theorize and test these relationships while identifying additional indicators. *The Social Impact Gap.* Research has focused predominantly on gender in STEM, neglecting fields like nursing and other underrepresented groups (e.g., encouraging men to enter stereotypically female professions). Exploring this area could generate insights into broader inclusivity across educational domains, aligning with societal and organizational needs. Expanding the focus to address broader biases related to race, socioeconomic status, and educational domains is critical for societal impact. Table 3 summarizes these gaps, providing a research agenda for advancing the field.

6.2 Implications

Research: This study contributes to IS knowledge by incorporating social science theory, specifically Stereotype Threat Theory, into the design of inclusive MOOCs, emphasizing the importance of interdisciplinary research. The findings of this study align closely with the growing focus in IS and HCI research on addressing diversity, equity, and inclusion challenges in digital environments. HCI's emphasis on ethical considerations, well-being, accessibility, and inclusion in technology-augmented environments [37] resonates with the study's purpose to identify solutions that exemplify how technology can be leveraged to foster equity and mitigate barriers like stereotype threat. The emphasis on participation, psychological, and performance indicators as measures of success directly contributes to the IS field's goal of developing more comprehensive frameworks for evaluating equity-focused interventions. The broader perspective on strategies for fostering inclusivity in MOOCs supports the development of equitable digital learning spaces and aligns with global initiatives. The proposed research agenda offers valuable research directions for further exploration.

Practice: This study provides actionable insights for educators and MOOC designers to combat stereotype threat and increase inclusivity. By integrating the six inclusive design solutions and leveraging the three success indicator categories, designers can create high-quality, equitable learning experiences for underrepresented groups while maintaining value for existing learners. This approach not only fosters diversity and equity but also increases participation, improving scalability and profitability for course creators. Societally, these practices promote diversity in STEM and other fields, while supporting the European Union's Global SDGs and the European Commission's education goals [23, 25], which promote quality education and reduced inequalities as key objectives while addressing challenges such as stereotypes, equity and inclusion.

6.3 Limitations

The results of the study should be interpreted in consideration of two limitations. Firstly, while the search strategy and analytical framework were comprehensive and covered a long search period, capturing a view of the established research trends up to 2022, more recent developments may have been excluded. As this is an emerging research area, it is imperative to conduct ongoing reviews and updates in order to capture new developments. Furthermore, it is recommended that subsequent years following the search period of this study be examined to achieve a more comprehensive understanding of the field. Secondly, despite efforts to ensure objectivity through collaborative review, subjectivity in the review of the articles cannot be excluded entirely. While the concept matrix provides valuable insights, it is essential to recognize its non-comprehensive nature: differences in focus may arise due to variations in application domains, author perspectives, and ethical considerations, which can evolve over time, across cultures, and in response to societal changes. This highlights the need for continuous critical evaluation of findings as the field evolves [101].

7 Conclusion

This paper synthesized existing research on strategies for fostering inclusivity in MOOCs through a systematic literature review, focusing on methods to combat stereotype threat. MOOCs hold immense potential to address stereotype threat in education and foster equity across diverse learner groups. By adopting inclusive design solutions such as personalization, anonymity, and mindset change, MOOCs can mitigate barriers associated with stereotypes and create supportive environments that empower underrepresented learners, particularly in fields like STEM. While inclusive MOOCs cannot eliminate systemic inequities, they represent a crucial step in advancing societal goals of diversity and equity in education. This study emphasizes the importance of raising awareness about stereotypes in education and challenges the existing literature's focus on single-solution approaches. By systematically reviewing the research, a comprehensive meta-perspective is presented, aggregating prior findings into actionable insights for inclusive MOOC design and providing a foundation for addressing stereotype threat effectively. From a practical standpoint, the designers of MOOCs are encouraged to implement these solutions to enhance learning experiences and promote diversity. This approach has the potential to benefit underrepresented groups and to contribute to the creation of a more equitable future in which learners can flourish, regardless of background or prevailing stereotypes. This aligns with the European Union's Global SDGs and the European Commission's education goals. For researchers, this study identifies four critical research gaps—single solution, overarching solution, success indicators, and social impact gap. It also proposes 12 research questions to guide future work. These gaps highlight the need for interdisciplinary approaches and the integration of social science theories, such as Stereotype Threat Theory, into IS research. By addressing these challenges, future studies can further advance the design of inclusive MOOCs, ensuring their scalability and relevance in diverse educational and societal contexts. Continuous reviews and critical evaluation of findings are advised to capture new developments, as the field evolves, and the study's search period is limited. This study calls for ongoing efforts to challenge prevailing educational paradigms and leverage MOOC platforms as instruments to foster equity, empower learners, and address systemic disparities in education and beyond. By promoting inclusive design practices, this study contributes to the creation of digital learning environments that enable all learners to thrive, regardless of their background.

Author contributions KMI conceptualized the article as the first author and designed the research methodology. She carried out the systematic literature review and the subsequent qualitative content analysis. Ms. Illgen wrote the main manuscript text, was in charge of drafting all chapters, and undertook the final review and comprehensive revision of the article. As co-author, LG supported the conceptualization of the article and the design of the research methodology. She supported the systematic literature review, carried out the subsequent qualitative content analysis, and contributed in particular to the results section (Chapter 4) and significantly to the design of the research agenda in Chapter 5. She also carried out a critical review of the article. DS supported the conceptualization of the article and the design of the research methodology as co-author. He supported the systematic literature search, analyzed the metadata, and contributed primarily to the methodological section. He also carried out a critical review of the article. As co-author, JHB supported the categorization of the article in the field of business informatics research and education, provided feedback, and suggested revisions throughout the research and writing process. He helped to conceptualize and reflect on the methodological approach. All chapters were corrected and revised by him—OT, as co-author critically reflected on the content and methodological orientation of the article and discussed it with the co-authors.

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