Queering software engineering education: integrative approaches and student experiences

Queering Software Engineering Education: Integrative Approaches and Student Experiences

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***Abstract*—This systematic literature review examines the state of LGBTQIA+ inclusion in software engineering education. The review synthesizes findings from various studies to highlight the experiences and perceptions of LGBTQIA+ students and educators, as well as the impact of inclusive pedagogical practices. Results indicate a predominantly heteronormative and exclusionary climate negatively affecting LGBTQIA+ students' sense of belonging and retention. Innovative pedagogical approaches, such as integrating LGBTQIA+-inclusive problem sets and readings on diversity, show promise in fostering more inclusive environments. The review underscores the need for systemic changes, including increased visibility of LGBTQIA+ issues, diversity training, and supportive networks, to create a more inclusive and equitable educational landscape. Future research should focus on expanding these efforts and exploring the perspectives of LGBTQIA+ educators to fully understand and address the challenges they face within software engineering higher education.**

***Index Terms*—educators, equality, LGBTQIA+, software engineering, students**

I. Introduction

The integration of equality, diversity and inclusion (EDI) into software engineering education has become increasingly important as the field evolves. The focus of this is typically gender and ethnicity based, when considering such intersectionality [1]–[3]. However, LGBTQIA+ individuals often face significant barriers in this discipline, such as lack of representation, and limited support systems. This systematic literature review (SLR) aims to investigate the current landscape of LGBTQIA+ inclusion in software engineering higher education, focusing on both student experience. By examining various studies, this review seeks to identify effective pedagogical practices to foster a more inclusive and supportive environment for LGBTQIA+ individuals in software engineering higher education. This study also highlights the current lack of work investigating the insights of LGBTQIA+ educators within software engineering higher education and some possible insights into why this might be the case.

The aim of this work is to understand the current landscape of research relating to LGBTQIA+ individuals within software engineering education, and what issues they currently face. Guiding this work is the following research questions (RQs):

- *RQ1*: What specific interventions and strategies enhance the academic engagement and learning outcomes of LGBTQIA+ students in software engineering higher education?
- *RQ2*: What challenges are faced by LGBTQIA+ educators within software engineering higher education?

The remainder of the paper is organized as follows: In Section II, the background literature is summarized. The methodology for the SLR is presented in the subsequent section, including the need for the SLR, the formulation of the *RQs*, search and screening procedures, and data extraction. Section IV provides results of the data extraction of the selected primary studies, followed by a discussion of the individual primary studies. Lastly, VI provides some concluding remarks.

II. Background

A. Related Work

Software engineering education inclusion of EDI underscores a growing recognition of its importance for fostering an inclusive learning environment. Prior works have primarily centered on the broader implications of EDI in engineering disciplines, with a significant focus on addressing the experiences and challenges faced by LGBTQIA+ individuals within these fields. From a software development perspective within the workplace, it has already been shown in a SLR that there is limited research on EDI within software engineering teams, pointing to a sporadic focus on EDI despite a robust discourse on diversity [4]. This strengthen the argument that software engineering higher educations needs to ensure EDI is considered and included at that early stage of those students careers in the hopes of it having a lasting impact into the workplace. Furthermore, the SLR in [4] underscores a pressing need for more comprehensive research that not only addresses diversity but also delves deeper into EDI practices within software development teams. Interestingly, the SLR in [1] also highlights the importance and need for EDI in software engineering as well but neglects to include aspects LGBTQIA+ individuals.

Considering more specifically the educational context, an SLR was conducted to investigate the impact of inequalities within computer science education researchers [5]. It was found that that addressing these disparities requires systemic changes that go beyond curricular adjustments to include support networks and visibility for underrepresented individuals. In a similar vein, [6] investigated the visibility of

LGBTQIA+ individuals in computer science and software engineering education, arguing for the necessity of inclusive educational practices that recognize and value diversity in all its forms. Similar to the workplace related work the authors in [6] called for educational reforms that integrate inclusive content throughout the software engineering curriculum to better support LGBTQIA+ students.

B. Intersectionality

Intersectionality recognizes the complex interplay of multiple social identities, such as ethnicity, gender, class, and sexual orientation, contributing to unique experiences of discrimination or privilege. For instance, [2] explored intersectionality in the development and use of software, emphasizing the need for equitable data practices that reflect diverse identities. It identified significant gaps in representation within data sets used in technology, underscoring the need for contributions that support inclusive research and development practices. However, the work does not explicitly address LGBTQIA+ identities within its exploration of intersectionality in software development.

In software engineering education, understanding intersectionality is crucial for developing inclusive pedagogical practices and curricula that address the nuanced needs of diverse student populations. The work in [7] investigated integrating intersectionality into software engineering curricula, advocating for educational reforms that include diverse identities and experiences. It is clear from [7] that intersectionality findings should not necessarily be generalized across countries, as students from each country have different contexts. However, what was apparent is that LGBTQIA+ students were concerned about their sense of belonging in higher education, not only amongst their peers but also from their educators. That work points to the necessity of curriculum designs that reflect a broad spectrum of social identities to enhance inclusivity in software engineering programs. Other similar work, though may briefly mention LGBTQIA+ individuals as part of intersectionality, but it is not fully addressed [8], with the predominant issue presented being centred on gender [3]. Therefore, the integration of intersectionality into software engineering education requires a deliberate and thoughtful approach to curriculum development, pedagogical strategies, and student support services. However, greater emphasis should be placed on trying to understand what improves the experiences of LGBTQIA+ individuals, which is less represented. By acknowledging and addressing this, there is the potential to improve EDI within the software engineering industry [9].

III. Methodology

In this section, we outline the methodology conducted in a SLR to examine how the computing education research community has discussed LGBTQIA+ students and educations within higher education. Following guidelines by Kitchenham et al. [10], we articulate the need for this review, formulation of the research question, data sources and search procedure, data extraction with a codebook, and data synthesis. The SLR guidelines by Kitchenham et al., were chosen because they been highly adopted [11], [12], and is applicable to software engineering education.

A. Formulating the RQs

To formulate our RQs defined in Section I, we followed Kitchenham et al.'s recommendation to include the population, the intervention, the comparison, and the outcomes in the research question [10]. First considering LGBTQIA+ students within software engineering higher education, we sought to understand what might improve their experience (*RQ1*). Subsequently, we wanted to understand how might educators also improve their experience (*RQ2*).

B. Search Procedure

To focus the SLR on software engineering education research, the search was limited to publications in the following databases: the Institute of Electrical and Electronics Engineers (IEEE) Xplore Digital Library [13], hereby known as IEEE Xplore, and the Association for Computing Machinery (ACM) Digital Library [14], hereby known as ACM. These databases were chosen because they are most relevant to the area of research and are full-text databases. Both of these databases publish papers that are in proceedings of educational conferences, as well as technical conferences, which often have an education track.

It was essential to create a database query that would be comprehensive to include all relevant papers. Therefore, all synonyms and related terms of interest to the RQs were clearly defined as shown in Table I. The first column in Table I gives variants of the terms related to LGBTQIA+. The terms in the second column refer to both staff and students. The third column contains terms that relate to education. The queries were searched for in all metadata within each database using the following, "*(LGBT*) AND (student* OR staff OR graduate*) AND (education* OR curricul* OR program*)*". There was no filter on the year of publication or type of publication. The type of publication is considered in the inclusion and exclusion criteria of the screening procedure in Section III-C. A snowballing approach [15] was not utilized to add papers to our analysis, as this approach could potentially lead to papers published outside of IEEE Xplore and ACM. The focus on IEEE Xplore and ACM allowed for consistency in the search mechanism as well as restrictions to access.

TABLE I: Database search terms.

Term 1	Term 2	Term 3
LGBT*	student*	education*
	staff	curricul*
	graduate*	program*

C. Screening Procedure

For the screening procedure of the primary studies selected for further analysis, inclusion and exclusion criteria were defined for four rounds, as shown in Table II.

TABLE II: Inclusion and exclusion criteria.

	Round 1 (type)	Round 2 (title)	Round 3 (duplicates)	Round 4 (abstract)	Round 5 (article)
Inclusion criteria	Research article	Indicates that the paper does talk about LGBTQIA+ individuals in software engineering higher education.	-	Indicates it is relevant to the *RQs*.	-
Exclusion criteria	Not a research article	Indicates that the paper does not talk about LGBTQIA+ individuals in software engineering higher education.	Duplicates excluded.	Indicates it is not relevant to the *RQs*.	Not written in English.
	Not available.				Incomplete.
	Work in progress.				
	It is a survey, SLR or meta-analysis.				

The first round considers the title of the publications. The second round removes any duplicate results. The third round applies the criteria to the abstract and the last round removes articles not written in the English language or are incomplete. One researcher carried out the selection process for each publication. As noted in Kitchenham et al.'s guidelines [10], the results of inclusion and exclusion was discussed with another researcher to ensure consistency of inclusion/exclusion decisions.

An initial search of the databases was made on May 15, 2024. This yielded 16 and 707 results respectively, from IEEE Xplore and ACM. In round 1, 204 publications were excluded, and 500 publications were excluded in round 2. In round 3 of the inclusion and exclusion process 0 were excluded as there were no duplicates. In round 4, 11 publications were excluded for abstracts not relating to the *RQs*. In round 5, no publications were excluded. The final total at the end of the inclusion/exclusion process was thus 9 research articles. This is summarized in Fig. 1, which uses the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) flow diagram template from [16].

D. Quality Assessment

The quality of the screened primary sources was assessed based on criteria adopted from Kitchenham et al.'s guidelines [10], focusing on the methods utilized and their scientific rigor.

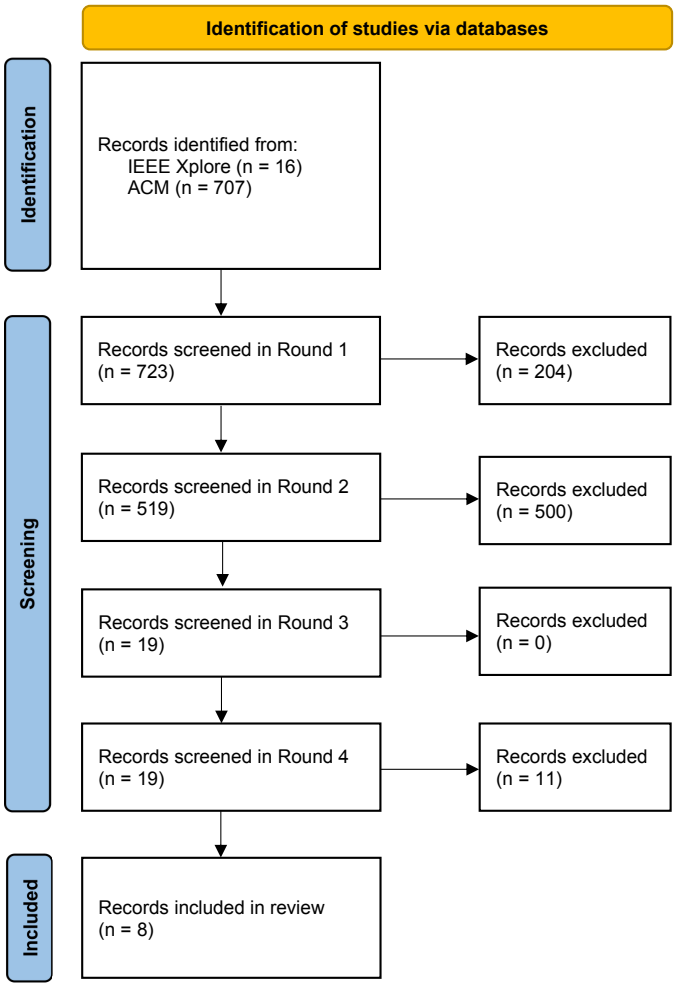

Fig. 1: PRISMA 2020 flow diagram for the SLR, summarizing the details of the screening procedure.

For primary sources based on field studies with qualitative and quantitative (QQ) approaches, the criteria were:

1) How well was the data collection carried out?
2) How well was the approach to, and formulation of, the analysis conveyed?
3) How well were the contexts and data sources retained and portrayed?
4) How clear and coherent were the links between data, interpretation, and conclusions?

For primary sources that were theoretical (T) based, the criteria were:

1) How well did the analysis address its original aims and objectives?
2) How has knowledge or understanding been extended by the research?
3) How well was diversity of perspective and context explored?

The quality assessment (QA) was performed by one researcher, and each paper was scored on the scale (for each criterion):

- 1 - very poorly;
- 2 - poorly;
- 3 - reasonably;
- 4 - well;
- 5 - very well.

The results of this was discussed with another researcher to ensure objectivity. A table of the QA scores of the primary sources is provided in Table III. It is clear from the table that all of the screened primary sources scored "*very well*" across all of the applicable criterion. This is expected since all the primary sources, were published in peer-reviewed scientific journals or conference proceedings. Therefore, no screened primary sources were excluded at this stage based on the QA scores.

TABLE III: QA for each of the included primary sources.

		Criterion			
Paper Reference	Method	(1)	(2)	(3)	(4)
[17]	QQ	4	4	4	4
[18]	QQ	4	5	4	4
[19]	T	5	5	4	-
[20]	QQ	4	3	4	3
[21]	QQ	5	5	5	5
[22]	QQ	5	5	4	4
[23]	QQ	4	4	4	4
[24]	QQ	4	4	5	4

E. Final Dataset

The final dataset included eight published papers, with further details provided in Table IV. To understand the trend of research in this area the number of publications per year is shown in Fig. 2. From the figure it is clear that 75% of the dataset was published since 2019, and there are no papers published before 2013.

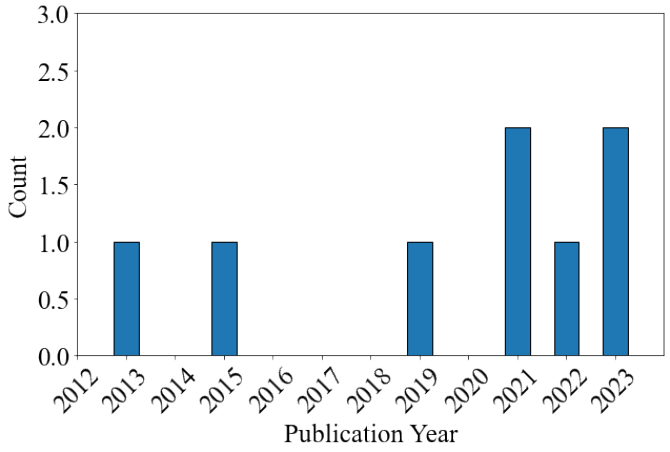

Fig. 2: Included papers by publication year.

F. Data Extraction

The RQs were approached close ended, to be answered by categorizing the papers in the dataset into discrete groups. Codebook analysis was used to maintain focus and to support consistency [10]. To create the codes related to *RQ1*, the all papers in the dataset were briefly read by a researcher, which was a achievable due to the number of papers in the dataset ($n = 8$). This then resulted in the codes that were discussed with another researcher and finalized into the groups and codes as shown in Table V. Four code groups consisted of non-exclusive codes, such that multiple codes from the group could apply to one paper (e.g., pedagogical strategy, and participant demographic). The codes created for *RQ2*, were then based off the codes generated for *RQ1*, and are shown in Table VI, with participant demographic being non-exclusive. One researcher then coded the papers and then discussed it with another researcher to ensure consistency and agreement [10].

TABLE IV: Full dataset of 9 included papers, by year, with publication type and name.

Paper Reference	Year	Publication Type	Publication Name
[17]	2013	Conference	IEEE Frontiers in Education Conference (FIE)
[18]	2015	Conference	Research in Equity and Sustained Participation in Engineering, Computing, and Technology (RESPECT)
[19]	2019	Conference	ACM International Conference on the Design of Communication
[20]	2021	Conference	Conference on Research in Equitable and Sustained Participation in Engineering, Computing, and Technology (RESPECT)
[21]	2021	Journal	IEEE Transactions on Education
[22]	2022	Conference	ACM Technical Symposium on Computer Science Education
[23]	2023	Conference	IEEE/ACM International Conference on Cooperative and Human Aspects of Software Engineering (CHASE)
[24]	2023	Conference	International Conference on Software Engineering: Software Engineering Education and Training

G. Positionality Statement

This research required analysis of written publications, which are situated within cultural and societal norms. It is acknowledged that bias can come from all authors and much of the computing and engineering education research community is situated in western, educated, industrialized, rich, and democratic societies that do not reflect most of the global population [25]. As software engineering educators and researchers, this work was embarked upon to find best practices to guide our own work. Therefore, the goal of this work is to constructively advance knowledge of and for the computing and engineering education research community, with a shared commitment to broadening participation and

TABLE V: Codes related to *RQ1*.

Code group	Code	Description
Intervention strategy	Single module	LGBTQIA+ students considered in a single, stand-alone module in a software engineering course.
	Extracurricular	LGBTQIA+ students considered from a software engineering course but in extracurricular context.
	Multiple institutions	LGBTQIA+ students considered across software engineering courses in multiple institutions.
	No mention	No mention of LBGTQIA+ students within a software engineering course context.
Pedagogical strategy	Participation	Teaching with active student participation, such as with class discussions. Does not include a student producing work or turning anything in.
	Exposure	Teaching with activities where knowledge is primarily generated by an instructor or other expert (e.g., lecture, reading, watching a video).
	Submitted work	Teaching by requiring a student to produce work that is submitted (e.g., homework, exam, essay, project).
	No mention	No mention of pedagogical strategy.
Assessment	Included	Can include assignments such as graded reflections, reports, exams, or presentations. Can also include measurement of students' attitudes or preferences.
	No mention	No mention of assessment.
Participant level	Undergraduate	Class intended for undergraduate students.
	Mixed	Class intended for a mix of graduate and undergraduate students.
	No mention	No student level explicitly mentioned.
Participant context	In class	The work was conducted within a classroom setting.
	In lab	Study was conducted in a lab environment.
	No mention	No mention of where the study was conducted.
Participant demographic	Gender	The work specified the gender breakdown of participants.
	Ethnicity	The work specified the gender breakdown of participants.
	Sexual orientation	The work specified the sexual orientation breakdown of participants.
	No mention	No mention of participant demographics.
Evaluation	Included	Study includes a formal evaluation of a hypothesis or an answer to a research question using formally defined research methods.
	No mention	Study recommends a course of action based on prior work, but may not formally test the idea (e.g., experience reports or provocation papers that describe a classroom experience).
Challenges	Included	Any negative consequences or challenges for LGBTQIA+ students in software engineering. Does not include study limitations.
	No mention	No explicit mention of challenges or hindrances related to LGBTQIA+ student.
Recommendations	Included	Explicit recommendations for how to improve engagement and learning outcomes for LGBTQIA+ students, including pitfalls to avoid, based on the paper's own findings.
	No mention	No explicit recommendation based on the paper's findings (even if then paper includes recommendations based on cited works).

TABLE VI: Codes related to *RQ2*.

Code group	Code	Description
Participant context	Undergraduate	The participant teaches undergraduate software engineering students.
	Postgraduate	The participant teaches postgraduate software engineering students.
	No mention	No mention of what students the participants teach.
Participant demographic	Gender	The work specified the gender breakdown of participants.
	Ethnicity	The work specified the gender breakdown of participants.
	Sexual orientation	The work specified the sexual orientation breakdown of participants.
	No mention	No mention of participant demographics.
Evaluation	Included	Study includes a formal evaluation of a hypothesis or an answer to a research question using formally defined research methods.
	No mention	Study recommends a course of action based on prior work, but may not formally test the idea (e.g., experience reports or provocation papers that describe a classroom experience).
Challenges	Included	Any negative consequences or challenges for LGBTQIA+ teaching staff in software engineering. Does not include study limitations.
	No mention	No explicit mention of challenges or hindrances related to LGBTQIA+ staff.
Recommendations	Included	Explicit recommendations for how to experiences for LGBTQIA+ staff, including pitfalls to avoid, based on the paper's own findings.
	No mention	No explicit recommendation based on the paper's findings (even if then paper includes recommendations based on cited works).

cultural competency. Further limitations of this work are stated in Section V-C.

IV. Results

Overall, the primary studies investigated LGBTQIA+ inclusion in a variety of ways. While some studies focused on clear implementation within specific modules, others focused primarily on understanding LGBTQIA+ experiences via surveys to multiple institutions. The results of the coding is present in this section.

A. RQ1

The analysis of the results, as illustrated in Fig. 3, provides a comprehensive overview of the coding related to *RQ1*. The intervention strategies varied across the studies. Some focused on LGBTQIA+ students within a single module in

a software engineering course, highlighting the potential for targeted interventions within specific courses. While one study considered LGBTQIA+ students in an extracurricular context. A few studies included LGBTQIA+ students across multiple institutions, providing a broader perspective on the challenges and interventions. Notably, a significant number of studies did not mention specific LGBTQIA+ interventions.

Regarding pedagogical strategies, active student participation, including class discussions, was a common approach. This method emphasizes engagement rather than merely submitting work. Teaching methods where knowledge is generated by an instructor or expert were also prevalent. Some studies required students to produce and submit work, such as homework, exams, essays, or projects, as part of the learning process. However, there were a significant number of studies that did not specify any pedagogical strategy. This was due to a number of the papers investigating the opinions of LGBTQIA+ students and not focusing on the results of a change in pedagogy. This is also reflected in the assessment, and participant context code groups.

The participant levels were mostly focused on undergraduate students, with a few studies including both graduate and undergraduate students. There were instances where the participant level was not explicitly mentioned. Demographic details of participants typically contained gender and sexual orientation, with some including ethnicity.

B. RQ2

Of the primary studies included within the dataset, none addressed *RQ2* and all results for the code groups are "no mention". Therefore, a figure or table detailing the results is not shown.

V. Discussion

A. RQ1

Several studies advocate for the development and implementation of specialized programs tailored specifically to the needs of LGBTQIA+ students. Such programs may include diversity and inclusion events, mental health panels, and support networks that involve LGBTQIA+ faculty. These initiatives not only provide targeted support but also raise awareness of LGBTQIA+ issues within the academic community, fostering a more inclusive atmosphere [20], [21].

The role of faculty as mentors and role models is crucial in shaping the academic experience and enhancing the sense of belonging among students. Facilitating informal interactions between faculty and students can help in building supportive relationships and enhancing students' academic engagement and confidence [17], [21]. Regular, informal interactions, such as mentorship programs and casual meet-ups, increase the visibility of supportive faculty and provide students with accessible role models.

Creating communities of practice within educational institutions provides a platform for ongoing dialogue on diversity and inclusion. These communities involve students, faculty, staff, and administrators in regular discussions that can drive policy changes and foster a culture of inclusivity. Such efforts are supported by findings that stress the importance of continuous engagement with diversity and inclusion topics to effect change [18], [21].

For substantive support of LGBTQIA+ students, comprehensive diversity and inclusion training for all members of the academic community is essential. This training should cover inclusive language, understanding of LGBTQIA+ issues, and effective allyship practices. Structured training programs, such as those offered by the ASEE Safe Zone Ally Training workshops, are instrumental in enhancing understanding and support for LGBTQIA+ individuals within educational settings [19], [21].

When creating assignments with improved inclusivity focus more on what people are doing and the context of the problems, rather than emphasizing their identities with labels alone [19]. This approach can help normalize diversity without making it the sole focus of the problem. Considering the novelty of such affirming problems for many students, introducing the concept of inclusivity at the beginning of the course can help in setting expectations. This can be done during syllabus reviews or initial lectures where the course's EDI policies are discussed [22]. Furthermore, assignments can cover a diverse range of underrepresented groups and can include a reflective discussion [20]. Integrating these topics within the curriculum is the best case scenario, however this could be achieved in multiple subtle ways throughout a degree program, such as case studies, guest lectures, or projects [17].

B. RQ2

There remains a lack of literature from LGBTQIA+ educator perspectives within software engineering as shown in Section IV-B. This could possibly be due to the inherent low numbers of such educators. Yet, if there is indeed low numbers there will be inherent difficulty in trying to recruit participants for such work. Nonetheless, it would be a positive step towards understanding how being apart of the LGBTQIA+ community influences their experience of teaching and working within software engineering higher education.

C. Protocol limitations

This SLR is limited based on the search coverage and possible biases introduced during the study selection, data extraction, and analysis. These limitations were addressed by having a second researcher discuss the results of each stage to ensure consistency and appropriate decision making [10]. Readers and encouraged to view this study as a starting point for future work, potentially employing a snowballing approach to achieve a more exhaustive review, including a greater number of databases, and including a greater number of relevant search terms. Furthermore, considering the lack of results concerning *RQ2*, other databases and STEM related subjects could also be considered in the future.

VI. Conclusion

The findings from this SLR highlight the persistent challenges faced by LGBTQIA+ students in software engineering

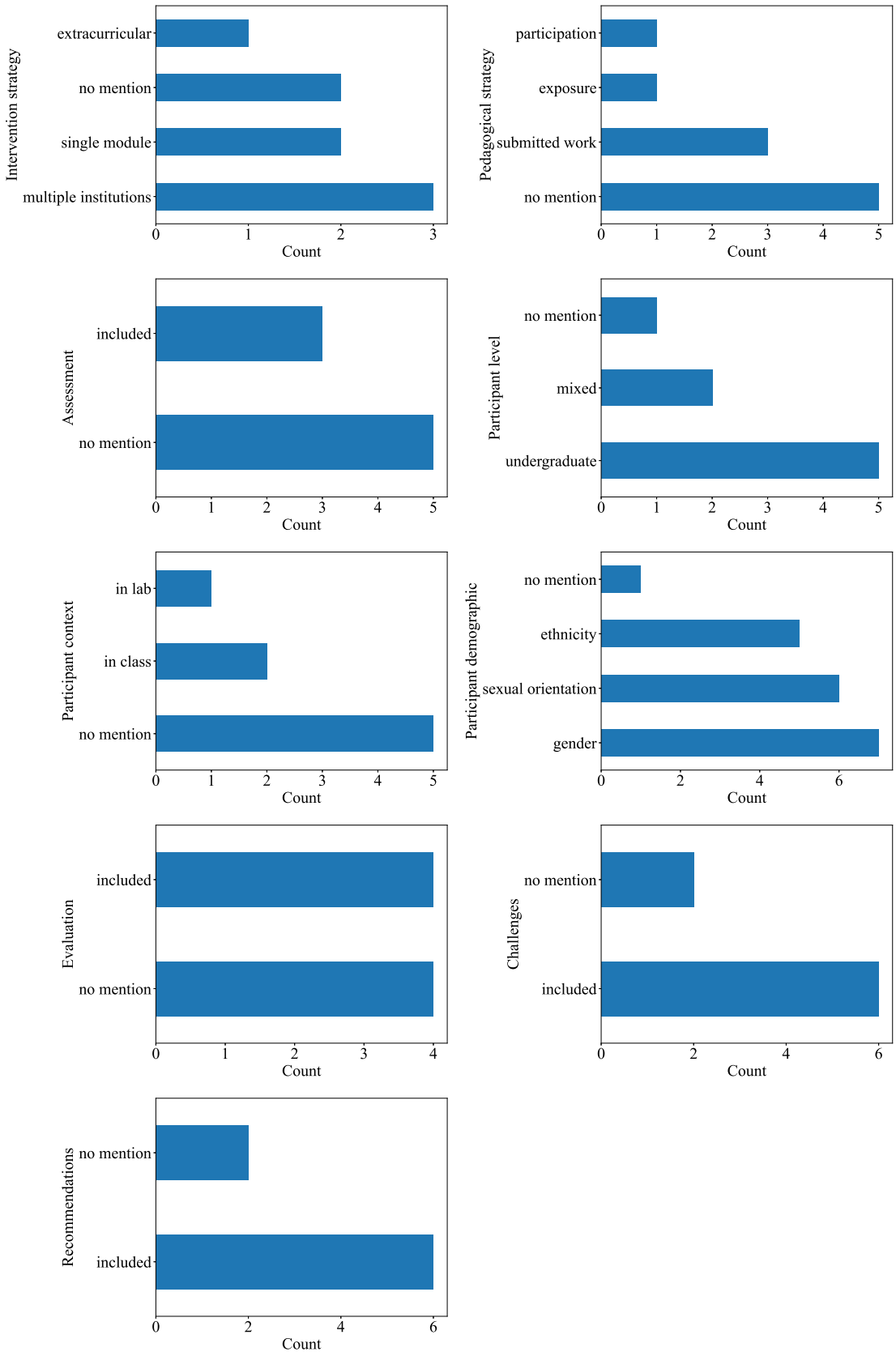

Fig. 3: Coding results for codes relating to *RQ1* in Table V.

higher education, including discrimination, exclusion, and lack of support. However, several innovative pedagogical approaches, such as the integration of LGBTQIA+ inclusive content and community-engaged learning, demonstrate the potential to create more inclusive and supportive educational environments. These strategies not only enhance the sense of belonging and retention for LGBTQIA+ students but also promote diversity and innovation within the field. Moving forward, it is crucial to continue developing and implementing inclusive curricula, providing comprehensive diversity training, and fostering supportive networks for both students and educators. Future research should also explore the perspectives of LGBTQIA+ educators to gain a more comprehensive understanding of the challenges and opportunities within STEM education. By addressing these issues, we can work towards a more equitable and inclusive academic landscape that benefits all members of the software engineering academic community.

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