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Cultural Diversity in Technology-Based Assessments: Innovations for Fair and Inclusive Evaluations in Higher Education

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ABSTRACT

Purpose of the study: This study aims to explore the implementation of Technology-Based Assessment (TBA) with a multicultural approach in higher education to reduce cultural bias, increase accessibility, and create a fairer and more inclusive assessment system for students from various cultural backgrounds.

Methodology: This study used a mixed-methods design with a convergent parallel approach. The sample in this study was taken using purposive sampling. Quantitative data were collected through an online survey using a Likert scale questionnaire created with Google Forms. Statistical analysis was performed using SPSS. Qualitative data were collected through semi-structured interviews. Thematic analysis was used to analyze qualitative data, ensuring comprehensive integration of findings.

Main Findings: Multicultural Technology-Based Assessment (TBA) improves accessibility and flexibility of assessment in higher education. However, cultural biases in item design and language barriers have been found to impact perceptions of fairness and inclusivity. Students from different cultural backgrounds have varied experiences, highlighting the importance of adapting TBA to reflect cultural diversity. A multicultural approach to TBA has been shown to reduce disparities and support a more inclusive assessment environment.

Novelty/Originality of this study: This study introduces a multicultural approach to Technology-Based Assessment (TBA) for the context of higher education in Indonesia, taking into account the diversity of cultures, languages, and local values. This study provides new insights into the development of inclusive and equitable TBA, offers practical solutions to reduce cultural bias, and broadens understanding in the design of technology-based assessments in multicultural environments.

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1. INTRODUCTION

As digital technology advances, universities around the world have begun to adopt various forms of technology-based assessment (TBA) in an effort to improve efficiency and reliability in assessing student academic achievement. Multicultural campuses aim to provide equal academic opportunities for students from diverse backgrounds [1]. Criticism of multiculturalism often stems from the presentation, not the substance [2]. The use of multicultural technology for assessment has great potential to increase transparency and fairness in the evaluation process [3] but also poses challenges in reflecting the academic abilities of students from diverse cultural backgrounds [4].

TBA allows educational institutions to utilize a variety of digital tools, from online exams, project-based assessments, to interactive simulations, to provide a more flexible and responsive assessment experience. The legal framework plays a role in integrating multicultural education into educator training in higher education [5]. Education in higher education varies according to the curriculum, challenging standardization [6]. Higher education has an important role in promoting equality and improving well-being among students from different backgrounds [7]. Multicultural education has become an important issue since the emergence of the civil rights movement [8].

Vocational education reflects increasing cultural diversity, which requires inclusive reforms in higher education [9]. Although TBA brings many advantages in terms of speed and accessibility, there are concerns about equity in its implementation, especially when faced with a student population with diverse cultural backgrounds [10]. In an increasingly global higher education environment, students come from different countries, cultures, languages, and educational backgrounds [11]-[14]. This diversity creates new challenges in designing assessment systems that are fair and inclusive for all students [15],[16].

Technology-based assessment has been a major focus in efforts to create more objective evaluation systems, but its effectiveness remains to be tested in the context of cultural diversity in educational environments [17],[18]. Social norms and cultural diversity influence the effectiveness of distance education in multicultural contexts [19]. Multicultural education aims to address cultural struggles and empower marginalized groups globally [20],[21]. The expansion of foreign language education is also essential to foster multicultural inclusivity in higher education [22],[23]. In TBA assessments, it is often expected to function as a neutral and objective assessment tool [24].

Therefore, it is important for higher education institutions to design TBA with multicultural principles so that the assessment results truly reflect students' academic abilities, without being influenced by cultural or language factors [25]-[27]. Technology-based assessments allow for a more efficient evaluation process [28]. Assessments are also designed to support student learning, not only evaluating performance but also promoting and enhancing the learning process despite having different backgrounds [29]. This diversity of learning styles needs to be taken into account so that TBA can accommodate the academic needs of each student, thus creating an inclusive and equitable learning environment [30],[31]. Thus, a multicultural approach in TBA not only increases equality but also supports students in developing their potential optimally. With the right approach, TBA has the potential to be an effective tool in creating an inclusive assessment environment [32],[33].

Previous research shows that the integration of technology, especially Artificial Intelligence (AI), in educational assessment has provided great opportunities to create a more inclusive assessment system [34]. However, this research has focused more on the K-12 context in developed countries such as the United States, with approaches that do not take into account local and contextual diversity. In addition, although there are frameworks for equity and inclusivity, much of this previous research fails to address the cultural and linguistic challenges faced by individuals, thereby risking exacerbating existing biases. Technology-based approaches to assessment often ignore local needs and do not accommodate cultural diversity, which is a significant problem in countries with multicultural populations such as Indonesia.

The current study aims to address this gap by exploring the implementation of multicultural Technology-Based Assessment (TBA) in higher education in Indonesia. Using a mixed methods approach, this study not only identifies challenges faced in designing equitable TBAs but also offers practical solutions that are relevant to the local context. This study is innovative because it integrates multiculturalism principles into the design, implementation, and evaluation of TBAs, which are designed to accommodate the needs of students from diverse cultural backgrounds. In addition, this study contributes to the development of an inclusive framework in higher education, which differs significantly from previous research focusing on K-12. Using a holistic and context-based approach, this study provides strategic recommendations for higher education institutions to reduce cultural bias, increase accessibility, and ensure assessment results that fairly reflect academic competencies [35],[36].

Multicultural TBAs can help reduce inequities in academic assessment and support universities in creating more inclusive educational environments. Technology can support diversity in assessment and enrich the learning experience in higher education environments [37],[38]. Furthermore, studies have shown that students from minority or international cultural groups often face greater barriers in navigating non-inclusive assessment systems [39]. Therefore, this study aims to explore how TBAs can be designed with a multicultural approach that takes into account the cultural diversity of students in higher education [40],[41]. This study also provides novelty

by developing TBAs that are not only locally relevant but also provide practical guidance for universities in designing inclusive and equitable assessment systems.

The focus on the cultural diversity of students in Indonesia makes this study very contextual and significant in efforts to support academic equality and create more inclusive learning environments in the era of globalization. This study is expected to provide practical recommendations for universities to implement TBAs that are responsive to cultural diversity, so as to improve fairness in academic assessment and strengthen the relevance of higher education in the era of globalization. The application of Technology-Based Assessment (TBA) in higher education presents a great opportunity to create a more equitable, inclusive, and culturally responsive assessment system. However, significant challenges related to cultural bias, language, and inappropriate question design often arise, which can affect the assessment outcomes of students from diverse backgrounds. By utilizing a multicultural approach, TBA can be designed to accommodate the needs and characteristics of students from different cultures.

2. RESEARCH METHOD

2.1. Types of Research

This study uses a mixed methods approach with a convergent parallel design. This approach was chosen to combine quantitative and qualitative data collected in parallel at the same stage, thus providing a deep and comprehensive understanding of the application of multicultural-based assessment technology in higher education. With this design, quantitative and qualitative data are analyzed independently first, then the results are integrated to obtain a comprehensive interpretation [42],[43].

2.2. Data Collection Process

Quantitative data were collected through an online survey by distributing a questionnaire to students from various cultural backgrounds. The survey included closed-ended questions and Likert-type scales to measure students' perceptions of fairness, ease of use, and inclusivity of technology-based assessment (TBA) in a culturally diverse context. The questionnaire was designed to explore potential cultural biases that may arise in the design and implementation of TBA. The survey results were analyzed using descriptive statistics to find patterns, trends, and differences in perceptions across cultural groups. Qualitative data were collected through in-depth interviews with students and educators from various cultural backgrounds. The interviews were conducted in a semi-structured manner to explore their experiences with implementing TBA, specifically related to fairness, cultural sensitivity, and inclusivity. Interview data were analyzed using a thematic approach to identify key themes that emerged, such as challenges, opportunities, and recommendations for improving the implementation of multicultural TBA. The grid of this research instrument can be made by considering the main aspects to be measured, such as fairness, ease of use, and inclusivity of Technology-Based Assessment (TBA) in a multicultural context. The following is a draft of the grid of this research instrument:

Table 1. Quantitative questionnaire grid

No.	Measured Aspects	Indicators
1	Fairness	- TBA treats students from different cultures equally - TBA questions reflect diverse cultural values
2	Ease of Use	- TBA is easy to use for students from different cultures - There are no technical barriers to implementing TBA
3	Inclusivity	- TBA uses inclusive language - TBA takes into account local cultural context

Then the qualitative interview guide instrument grid is presented in table 2 below:

Table 2. Interview guideline grid

No.	Measured Aspects	Indicators
1	Fairness	- Perception of fairness in implementing TBA
2	Ease of Use	- Technical ease of using TBA
3	Inclusivity	- Use of inclusive language and questions - Relevance of TBA questions to cultural values

2.3. Population and Research Sample

The population in this study were students with diverse cultural backgrounds, covering various study programs and higher education institutions that use technology-based assessment (TBA) in the academic process. The research sample was selected purposively to ensure the diversity of cultural representation in the data collected. The sample for quantitative data consisted of 15 students selected based on inclusion criteria, such as

experience using TBA in academic evaluation and different cultural backgrounds. Meanwhile, the sample for qualitative data included 15 respondents, consisting of students, who were interviewed in depth to explore their experiences related to justice and cultural sensitivity in TBA. This approach aims to ensure that the data obtained reflects diversity and provides results that are relevant to the research objectives. In this study, the population that is the focus is the individuals involved in the related study. The research sample consisted of 15 respondents who were selected purposively, with certain criteria that are relevant to the research objectives. This sample selection aims to obtain representative and relevant data, although the number is limited, so that the results obtained can provide a fairly accurate picture of the phenomenon being studied.

2.4. Research Procedures

This research was conducted in stages starting from planning survey instruments and interviews, data collection, to data analysis. The survey was conducted first, followed by interviews to elaborate on the results obtained from the survey. Each research participant, both those who took the survey and the interview, was given an explanation of the purpose of the research and asked for written consent to participate. The interview process was conducted online to facilitate participation and maintain participant confidentiality. With this mixed methods design, the research is expected to provide in-depth insights into students' and educators' perceptions of the implementation of multicultural TBA, as well as produce relevant recommendations for universities in an effort to build a more inclusive and fair assessment system for students from various cultural backgrounds.

2.5. Data Analysis Techniques

The data analysis technique in this study used a mixed methods approach with a convergent parallel design. Quantitative data were collected through an online survey using a questionnaire that included closed-ended questions and a Likert scale. Quantitative data analysis was carried out using descriptive statistical methods to identify patterns and trends in students' perceptions of multicultural Technology-Based Assessment (TBA). Meanwhile, qualitative data were collected through in-depth interviews with students and educators from various cultural backgrounds. Qualitative data analysis was carried out using a thematic approach to identify key themes related to challenges, opportunities, and recommendations in implementing multicultural TBA. The integration of quantitative and qualitative results was carried out to provide a comprehensive interpretation, resulting in in-depth insights into the effectiveness of TBA in creating fair and inclusive assessments in higher education, then Descriptive statistics were also used to describe and analyze the characteristics of data from each cultural group. In the table above, the average value (mean) of each cultural group shows students' perceptions of Technology-Based Assessment (TBA) in three different aspects (Score 1, Score 2, and Score 3) The Likert scale was also used to process quantitative data from this study.

Table 3. Likert scale in measuring quantitative data

No	Category
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

3. RESULTS AND DISCUSSION

This study collected quantitative data using a Likert scale questionnaire (1–5) measuring students' perceptions from various cultural backgrounds on fairness, ease of use, and inclusiveness of Technology-Based Assessment (TBA). The survey data were analyzed using descriptive statistics to find patterns and trends in perceptions across cultural groups.

Table 4. Results of descriptive statistical tests

Culture	Score 1 (Justice)	Score 2 (Ease of Use)	Score 3 (Inclusivity)
Batak	4.67	3.00	2.33
Minang	4.00	4.50	3.00
Sunda	3.80	4.00	2.60
Chinese	3.60	3.20	3.20

Based on the results of quantitative analysis, students' perceptions of Technology-Based Assessment (TBA) showed significant variations across cultural groups. The Batak cultural group had the highest score in the fairness aspect (4.67), indicating that they felt that TBA was quite fair, but had the lowest score in inclusivity (2.33), indicating that the TBA design did not reflect their cultural diversity. On the other hand, the Minang cultural

group gave the highest score in ease of use (4.50), indicating that TBA was considered flexible and accessible, although its inclusivity only scored moderately (3.00). The Sundanese cultural group showed relatively balanced scores in the fairness aspect (3.80) and ease of use (4.00), but their inclusivity score remained low (2.60), reflecting the need for adjustments to be more inclusive. Meanwhile, the Chinese cultural group gave more stable scores in all aspects, with the highest score for inclusivity (3.20), but their perception of fairness (3.60) remained lower than other cultural groups. Overall, these results suggest that students from different cultural backgrounds have varying experiences with fairness, usability, and inclusiveness in TBAs. Cultural bias in question design and technical language are key challenges that need to be addressed. Therefore, it is important for universities to develop TBAs that are more responsive to cultural diversity, ensuring that all students feel represented and treated fairly in the assessment process.

Qualitative data from 15 respondents who participated in this study. Each respondent came from a different cultural background and major, providing diverse perspectives on the implementation of multicultural technology-based assessment (TBA) in higher education.

Table 5. Implementation of Multicultural Technology-Based Assessment (TBA) in Higher Education.

No	Respondent Code	Cultural Background	Department	TBA's Opposition Views on Multiculturalism
1.	R1.	Javanese	Information Technology	TBA was fair, but had difficulty understanding technical terms in English
2.	R2.	Minang	Economics	Thought TBA was flexible, but did not understand the context of the questions as they were too “western”.
3.	R3.	Sundanese	Communication Science	TBA helped to learn more effectively, but the test format was sometimes confusing.
4.	R4.	Batak	Psychology	Felt TBA was unfair because some questions were not relevant to cultural values.
5.	R5.	Chinese	Management	TBA was very helpful, but needed good technology support at home.
6.	R6.	Balinese	Education	TBA made assessments more objective, but questions needed to be more tailored to the local context.
7.	R7.	Bugis	Mechanical Engineering	Felt TBA was challenging because not all questions had answer choices that were in line with cultural values.
8.	R8.	Madurese	Law	Disagree with TBA because there was less direct interaction with the teacher.
9.	R9.	Malay	Sociology	TBA made assessments easier to access, but some questions did not fit local cultural understanding.
10.	R10.	Javanese	English Literature	TBA improved technological capabilities, but many questions were too focused on international standards.
11.	R11.	Bugis	Medicine	Felt TBA was ineffective because it was difficult to measure clinical skills through technology-based tests.
12.	R12.	Batak	Civil Engineering	TBA saved time, but had difficulty understanding terms that were not common in the local language.
13.	R13.	Balinese	Architecture	TBA was very flexible, but there were concerns about data security when taking online tests.
14.	R14.	Minang	Philosophy	Liked TBA for its flexibility, but questions needed to reflect more cultural differences.
15.	R15.	Sundanese	Mathematics	TBA is considered effective, but does not like questions that are too technical and not appropriate to the local context.

The results of the study indicate that technology-based assessment (TBA) has great potential in increasing the flexibility and efficiency of assessment in higher education. Most respondents stated that TBA facilitates access

to assessment and provides opportunities for students to take exams more flexibly, especially for those with mobility or time constraints [44],[45]. However, there are significant challenges related to cultural bias in question design and assessment instructions. Some respondents from certain cultural backgrounds found it difficult to understand technical terms or question contexts that were too culturally relevant to them, creating unfairness in the assessment process. In addition, language factors and understanding of cultural contexts play an important role in students' perceptions of TBA. Students from cultural backgrounds with different languages expressed difficulties in understanding some technical terms or questions that were written in unfamiliar languages [46]. This suggests that TBA that is not designed multiculturally can lead to inequalities in academic achievement, where students who are not familiar with the language or context of "Western-centric" questions are at a disadvantage. Therefore, efforts are needed to adapt TBA to be more responsive to cultural diversity, such as using more inclusive language and providing question options that are relevant to various cultural backgrounds [47].

The results of the current study, namely the implementation of technology-based assessment (TBA) with a multicultural approach in higher education, show that TBA designed with multicultural principles can reduce cultural bias, increase accessibility, and create a fairer and more inclusive assessment system. This study supports the results of previous studies that also show the importance of multicultural learning in forming technology-based tolerance values [48]. For example, previous studies found that the use of technology, such as digital devices, online learning platforms, and teachers' pedagogical skills in technology integration, contributed significantly to increasing the effectiveness of multicultural learning and tolerance.

However, the novelty of the current study lies in its specific focus on the context of higher education in Indonesia, which considers the complexity of cultural diversity, including differences in language and local values. In addition, this study uses a mixed methods approach to provide in-depth analysis that combines quantitative and qualitative data, resulting in more contextual recommendations than previous studies. The results of the current study also show unique challenges, such as cultural bias in item design and language barriers that were not fully addressed in previous studies. Thus, this study not only supports previous findings but also broadens the scope of understanding by providing new insights into the design of more inclusive TBAs for diverse populations. This study has significant differences compared to similar studies in other countries, especially in the context of implementing multicultural Technology-Based Assessment (TBA) in higher education environments. In some developed countries, such as the United States and European countries, TBAs have been well integrated, but there are still challenges related to cultural bias that often do not consider local diversity in depth. Meanwhile, this study specifically focuses on the context of higher education in Indonesia, taking into account the complexity of diverse cultures, including differences in language and local values [49]-[51]. The main advantage of this study is the holistic approach that combines mixed methods to explore student perceptions quantitatively and qualitatively, resulting in more relevant and contextual recommendations.

The short-term impact of this study is to provide practical guidance for universities in designing fairer and more inclusive TBAs, by reducing the potential for cultural bias. In the long term, the implementation of multicultural TBAs is expected to improve academic equality, create a more inclusive learning environment, and strengthen the higher education system in Indonesia. It will also support students from various cultural backgrounds to feel more represented and valued in the assessment process, thereby encouraging optimal and sustainable academic achievement [52]. Thus, the development of multicultural TBAs can be a solution to create a more inclusive and fair assessment environment in universities [53]. Educational institutions need to consider the cultural diversity of students in every aspect of technology-based assessments, including in the design of questions, assessment formats, and languages used [54].

The implementation of TBAs based on multicultural principles will not only help reduce bias in assessments, but can also improve the quality of learning by encouraging students to feel more represented and valued in the academic process [55]. This step is expected to create a more equal assessment system and support optimal academic achievement for all students, without exception [56]-[58]. This study has several limitations, including the limited number of respondents so that it is less representative, the focus on the Indonesian cultural context which is difficult to generalize, and the challenges in designing an inclusive TBA without a long-term trial. In addition, qualitative data collected through online interviews have the potential to cause subjective bias, and technological and infrastructure factors have not been fully explored. These limitations provide opportunities for further research with a wider scope and in-depth analysis.

4. CONCLUSION

This study shows that technology-based assessment (TBA) has significant benefits in terms of flexibility and efficiency, but also presents challenges related to cultural equity. Many students feel that TBA can make assessments easier to access, but there are concerns about cultural bias, especially in terms of the language and context of questions that may not be relevant to students from certain cultural backgrounds. These barriers can create inequities in assessment, where students who are not familiar with certain cultural terms or values may have difficulty achieving equitable outcomes. Therefore, it is important for universities to design TBAs that are more

inclusive and responsive to the cultural diversity of students. By considering multicultural aspects in the design and implementation of TBAs. Future research is recommended to develop more inclusive TBA designs, explore the influence of technology and infrastructure, test long-term implementation, improve educator skills through training, and engage a more diverse population of respondents.

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