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Advancing Sustainable Islamic Teacher Education: Developing a Zero-Waste Competency Instrument for Preservice Madrasah Teachers

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Abstract
The integration of sustainability into Islamic teacher education requires appropriate instruments to assess preservice teachers' competencies in promoting environmentally responsible practices. However, existing instruments mostly focus on general environmental attitudes or self-reported ecological behavior and rarely assess knowledge, self-efficacy, and zero-waste behavior together. This study aimed to develop and establish the content validity of a Zero-Waste Competency Instrument for preservice madrasah teachers. The instrument was developed through several systematic steps, including construct identification, blueprint development, Table of Specification (TOS) preparation, item writing, expert judgment, instrument revision, and pilot testing. The final instrument consisted of 52 items: 18 objective multiple-choice items measuring Zero-Waste Knowledge, 10 Personal Self-Efficacy statements, 12 Instructional Self-Efficacy statements, and 12 Zero-Waste Behavior statements. Content validity was assessed by four experts from the fields of environmental education, educational assessment, teacher education, and psychometrics using the Content Validity Index (CVI) approach following Lynn (1986) and the recommendations of Polit and Beck (2006) and Polit et al. (2007). The Item-Level Content Validity Index (I-CVI) was used to quantify item-level expert agreement, while the Scale-Level Content Validity Index based on the average approach (S-CVI/Ave) was used to summarize content validity across the instrument. All 52 items obtained an I-CVI of 1.00, and the overall S-CVI/Ave was also 1.00, indicating excellent content validity. Based on the experts' recommendations, eight items were refined, while no item required major revision or rejection. The revised instrument was then pilot-tested with 30 preservice madrasah teachers to examine its readability, clarity, and practicality. Overall, the instrument provides a content-validated framework for assessing zero-waste competencies among preservice madrasah teachers and a basis for further psychometric validation. It can support sustainability-oriented Islamic teacher education and provide a basis for further research on environmental education and Education for Sustainable Development (ESD).

Keywords:
Instrument development; content validity; zero-waste competency; sustainable Islamic teacher education; preservice madrasah teachers.

A. INTRODUCTION

The growing environmental crisis has increased the need for education systems to prepare learners not only to understand sustainability issues but also to turn their knowledge and values into responsible action. Education for Sustainable Development (ESD) views education as an important means of developing the knowledge, skills, values, and attitudes needed to make informed decisions and take responsible action for the environment and sustainable societies. UNESCO emphasizes that ESD should develop competencies that help learners consider the consequences of their actions and respond appropriately to complex sustainability issues. Therefore, sustainability-oriented education should not focus only on providing environmental knowledge. It should also connect knowledge with personal dispositions, pedagogical abilities, and actual action.

Teacher education has an important role in this process because preservice teachers will influence how younger generations understand and practice sustainability. Future teachers need not only to have sustainability-related knowledge but also to feel confident in integrating sustainability issues into classroom teaching and to demonstrate environmentally responsible practices in their daily lives. Recent studies in teacher education have also paid increasing attention to the relationship between sustainability competency and teacher self-efficacy. Karvonen & Kemi, (2023), for example, found that self-efficacy related to teaching values, ethics, and systems thinking was associated with variations in preservice teachers' perceived sustainability competency. Such findings suggest that preparing teachers for sustainability requires attention to both what prospective teachers know and what they believe they are capable of doing as educators.

Teacher education plays an important role in this process because preservice teachers will influence how younger generations understand and practice sustainability. Future teachers need not only to understand sustainability issues but also to feel confident in integrating them into their teaching and to practice environmentally responsible behavior in their daily lives. For this reason, recent studies in teacher education have increasingly examined the relationship between sustainability competency and teacher self-efficacy. Frick et al. (2004) showed that environmental knowledge has several dimensions, including system knowledge, action-related knowledge, and effectiveness knowledge. They also found that action-related and effectiveness knowledge were more directly related to conservation performance, while system knowledge had a more indirect relationship with behavior. This distinction provides a useful basis for assessing zero-waste knowledge through objective measures rather than relying only on general perceptions of environmental awareness.

The importance of combining knowledge with other competency components is also supported by recent sustainability research. A validation study involving preservice primary teachers developed a sustainability questionnaire covering knowledge, attitudes, and behaviors and found a continuing gap between sustainability-related knowledge and actual sustainable behavior. Similarly, research among preservice teachers in Indonesia showed that environmental education, environmental knowledge, and contextual facilities were related to intentions to separate and recycle waste. These findings suggest that sustainability assessment should consider several dimensions rather than using environmental knowledge or behavioral intention alone as indicators of sustainability competence. Building on these perspectives, this study conceptualizes zero-waste competency as a multidimensional capacity of preservice madrasah teachers to understand zero-waste principles, apply zero-waste practices in their personal lives, facilitate zero-waste learning in educational settings, and enact sustainable waste-related behaviors. This conceptualization recognizes that competency in zero-waste education involves not only what prospective teachers know,

but also their perceived capability to practice and teach zero-waste practices and their actual behavioral engagement. Accordingly, zero-waste competency is operationalized in this study through four complementary domains: Zero-Waste Knowledge (ZWK), Personal Self-Efficacy (PSE), Instructional Self-Efficacy (ISE), and Zero-Waste Behavior (ZWB)

Self-efficacy is important in this multidimensional perspective. From a social cognitive perspective, individuals' beliefs about their abilities influence how they approach tasks, persist when facing difficulties, and turn knowledge into action. In teacher education, teacher self-efficacy has been associated with instructional behavior, persistence, enthusiasm, and commitment. Tschannen-Moran and Woolfolk Hoy also emphasized the importance of carefully defining and measuring teacher efficacy because different instructional contexts may require different forms of efficacy beliefs (Tschannen-Moran & Woolfolk Hoy, 2001). For sustainability-oriented teacher education, this suggests that confidence in practicing environmentally responsible behavior may not be the same as confidence in teaching sustainability to students. Therefore, distinguishing Personal Self-Efficacy (PSE) from Instructional Self-Efficacy (ISE) can provide a clearer assessment of preservice teachers' readiness to practice and promote zero-waste behaviors.

The need for such an instrument is also important in Islamic teacher education. Madrasahs provide a distinctive educational context where environmental responsibility can be connected with Islamic ethical and spiritual values. Recent studies in Islamic education have explored concepts such as *khalifah* (stewardship), *amanah* (trust and responsibility), *mizan* (balance), and the prohibition of *fasad* and *israf* as foundations for environmental responsibility. These studies suggest that Islamic environmental education should not only add environmental topics to the curriculum but also integrate ecological values into teaching, school culture, and daily practices. Research in Indonesian Islamic educational settings has also shown the potential of eco-theological approaches to connect religious values with environmental ethics, ecological habits, and the development of sustainable character.

This context has also been addressed in previous work on zero-waste education for preservice madrasah teachers. Widayanti and Widyawati (2024) developed a zero-waste-based learning program for preservice elementary madrasah teachers to integrate waste management into environmental learning and sustainable development in Islamic teacher education. This work provides an important contextual basis for extending zero-waste education from a learning program to a systematic assessment of the competencies that prospective madrasah teachers need to develop. However, a learning program and an assessment instrument have different purposes. A program provides learning experiences, while a valid instrument is needed to determine whether prospective teachers have the knowledge, efficacy beliefs, and behavioral competencies that the program aims to develop.

Despite the growing research on sustainability competency, some limitations remain. Existing instruments often assess sustainability through broad areas such as knowledge, attitudes, values, intentions, or self-reported behavior. Recent studies involving preservice teachers have shown the value of combining knowledge, attitudes, and behavior, while other studies have examined sustainability competency together with self-efficacy. However, there is still limited evidence of an instrument specifically designed to assess zero-waste competency among preservice madrasah teachers by combining objective knowledge, personal self-efficacy, instructional self-efficacy, and zero-waste behavior. This context is important because sustainability competency in Islamic teacher education is not only related to environmental issues but also to the pedagogical responsibilities of future madrasah teachers and the ethical values of Islamic education.

Therefore, a contextually appropriate instrument is needed to provide a more complete assessment of zero-waste competency among preservice madrasah teachers. This study addresses this need by developing a Zero-Waste Competency Instrument consisting of four complementary constructs: Zero-Waste Knowledge (ZWK), Personal Self-Efficacy (PSE), Instructional Self-Efficacy (ISE), and Zero-Waste Behavior (ZWB). The development process included construct identification, blueprint and Table of Specification (TOS) development, item construction, expert judgment, content validation, revision, and pilot testing. Content validity was assessed using the Item-Level Content Validity Index (I-CVI) and the Scale-Level Content Validity Index based on the average approach (S-CVI/Ave). These indices provide a clear way to examine the relevance of individual items and the instrument as a whole. Polit and Beck emphasized that the method used to calculate the scale-level CVI should be clearly reported because different approaches may produce different estimates of content validity (Polit & Beck, 2006).

Accordingly, this study aimed to develop and establish the content validity of a comprehensive Zero-Waste Competency Instrument for preservice madrasah teachers. Specifically, the study aimed to: (1) develop an instrument operationalizing zero-waste competency through objective zero-waste knowledge, personal self-efficacy, instructional self-efficacy, and zero-waste behavior;; (2) examine the content validity of the items through expert judgment using I-CVI and S-CVI/Ave; and (3) examine the readability, clarity, and practicality of the instrument through pilot testing with preservice madrasah teachers. The study contributes to sustainability-oriented Islamic teacher education by providing a theoretically grounded and contextually relevant instrument that can support the assessment and further development of prospective madrasah teachers' capacity to promote zero-waste practices.

B. METHODS

This study used an instrument development and content validation design to develop a Zero-Waste Competency Instrument for preservice madrasah teachers. The development process was carried out systematically through several stages: construct identification, operationalization of constructs and dimensions, development of the instrument blueprint and Table of Specification (TOS), item construction, expert judgment, revision, and pilot testing. These stages were informed by established procedures for scale and instrument development, which emphasize construct definition, item development, content validation, pretesting, and subsequent psychometric evaluation (Boateng et al., 2018). The development process was guided by established theoretical frameworks and adapted to the context of zero-waste practices and the instructional responsibilities of preservice madrasah teachers.

The instrument integrated four complementary constructs: Zero-Waste Knowledge (ZWK), Personal Self-Efficacy (PSE), Instructional Self-Efficacy (ISE), and Zero-Waste Behavior (ZWB). ZWK was developed based on the multidimensional environmental knowledge framework of Frick et al. (Frick et al., 2004), particularly system knowledge, action-related knowledge, and effectiveness knowledge. PSE and ISE were grounded in the concept of self-efficacy proposed by Bandura (Bandura, 1997). and teacher efficacy theory developed by Tschannen-Moran and Woolfolk Hoy (2001). ZWB was contextualized from established ecological behavior and zero-waste frameworks, including Kaiser (Frick et al., 2004), Zaman and Matsui (Zaman et al., 2026) and the Zero Waste International Alliance framework. The constructs were operationalized into dimensions and indicators before the items were written.

A blueprint and Table of Specification (TOS) were prepared to ensure a clear alignment among the constructs, dimensions, indicators, content domains, and item specifications. For the knowledge component, the TOS also considered cognitive levels based on Bloom's taxonomy and included contextual and scenario-based questions

where appropriate. Each item was developed with its intended answer or response scale and a scientific rationale. The final instrument included objective multiple-choice items for ZWK, Likert-type statements for PSE and ISE, and a frequency-based response scale for ZWB. The detailed structure and characteristics of the instrument are presented in the Results and Discussion section.

The preliminary instrument was reviewed by four experts representing environmental education, educational assessment, teacher education, and psychometrics. Content validity was established using the Content Validity Index (CVI) approach, following the procedure proposed by Lynn (1986) and the recommendations of Polit et al (2007) and Polit & Beck (2006). This approach was used to quantify expert agreement on the relevance of individual items rather than relying solely on subjective qualitative judgments. The experts assessed each item in relation to its intended construct and target respondents, considering its relevance, clarity, appropriateness, and construct representation. At the item level, the Item-Level Content Validity Index (I-CVI) was calculated as the proportion of experts whose rating met the predetermined relevance criterion:

$$I\text{-}CVI = \frac{\text{Number of experts providing a qualifying relevance rating}}{\text{Total number of experts}}$$

At the scale level, the Scale-Level Content Validity Index based on the average approach (S-CVI/Ave) was calculated by averaging the I-CVI values across all items:

$$S\text{-}CVI/Ave = \frac{\sum I\text{-}CVI}{\text{Number of items}}$$

The CVI results were interpreted in accordance with established recommendations in the content-validity literature (Lynn, 1986; (Polit & Beck, 2006), In addition to the quantitative CVI assessment, qualitative comments from the experts were examined to identify issues related to wording, terminology, reading load, distractor quality, specificity, and alignment between items and their intended indicators. These comments were used to guide item refinement without changing the intended constructs, dimensions, indicators, or scoring procedures.

Following expert review and revision, the instrument was pilot-tested with 30 preservice madrasah teachers. The pilot test was mainly conducted to examine the readability, clarity, and practicality of the revised instrument for the target respondents. Feedback from the pilot test was used to identify any remaining problems in item wording, instructions, or administration. The pilot test was not intended to establish the full psychometric properties of the instrument. Further testing with a larger sample is needed to examine construct validity and reliability.

C. RESULT & DISCUSSION

The development process produced a 52-item Zero-Waste Competency Instrument with four complementary constructs: Zero-Waste Knowledge (ZWK), Personal Self-Efficacy (PSE), Instructional Self-Efficacy (ISE), and Zero-Waste Behavior (ZWB). The instrument views zero-waste competency as a multidimensional capacity that combines knowledge, efficacy beliefs, and sustainable behavior. This approach is in line with broader sustainability competency frameworks, which emphasize the combination of cognitive, intrapersonal, interpersonal, and action-oriented competencies rather than viewing sustainability as a single domain (Brundiers & Zint, 2021; Redman & Barth, 2021; Wiek & Redman, 2011). Recent reviews have also highlighted the continuing need to operationalize sustainability competencies through valid assessment instruments, particularly in higher education and teacher education

(Cebrián et al., 2020; Redman et al., 2021). The final instrument consisted of 18 ZWK items, 10 PSE items, 12 ISE items, and 12 ZWB items across twelve dimensions. The structure of the instrument is presented in Table 1.

Table 1. Structure of the Zero-Waste Competency Instrument

Construct	Dimensions	Number of Items	Measurement	Data Collection Technique
Zero-Waste Knowledge (ZWK)	System Knowledge	6	Multiple choice	Objective test
	Action-Related Knowledge	6	Multiple choice	Objective test
	Effectiveness Knowledge	6	Multiple choice	Objective test
Personal Self-Efficacy (PSE)	Behavioral Confidence	5	Likert 1–5	Questionnaire
	Persistence and Self-Regulation	5	Likert 1–5	Questionnaire
Instructional Self-Efficacy (ISE)	Instructional Strategy Efficacy	4	Likert 1–5	Questionnaire
	Classroom Facilitation Efficacy	4	Likert 1–5	Questionnaire
	Student Engagement Efficacy	4	Likert 1–5	Questionnaire
Zero-Waste Behavior (ZWB)	Sustainable Consumption Behavior	4	Frequency 1–5	Questionnaire
	Waste Management Behavior	4	Frequency 1–5	Questionnaire
	Environmental Participation Behavior	4	Frequency 1–5	Questionnaire
Total	12 dimensions	52		

The structure shows that the instrument goes beyond a conventional environmental knowledge or behavior scale. ZWK was assessed objectively through multiple-choice items, allowing the study to distinguish actual knowledge from perceived knowledge. Its three dimensions represent different forms of environmental knowledge: knowledge of environmental systems, knowledge of appropriate actions, and knowledge of the effectiveness of those actions. This distinction is consistent with environmental knowledge frameworks that differentiate knowledge about ecological systems, appropriate actions, and the effectiveness of those actions (Frick et al., 2004; Kaiser & Fuhrer, 2003). This distinction is particularly relevant to zero-waste education because knowing that waste can harm the environment does not necessarily mean knowing which actions are effective in reducing waste.

PSE measures confidence in personally performing and maintaining zero-waste practices, while ISE focuses on confidence in applying these principles in teaching. This distinction is based on self-efficacy theory, which refers to individuals' beliefs about their ability to organize and carry out actions needed to achieve particular outcomes(Bandura, 1997). In teacher education, however, efficacy is not limited to

general personal capability. Teacher self-efficacy also relates to teachers' perceived capability to organize and facilitate learning activities and influence student outcomes (Tschannen-Moran & Woolfolk Hoy, 2001). Previous research in sustainability education has also shown the importance of self-efficacy for preservice teachers' sustainability competency (Karvonen & Kemi, 2023; Malandrakis & Stanisstreet, 2019).

The distinction between PSE and ISE is therefore an important feature of the present instrument. Previous research on sustainability self-efficacy has shown that preservice teachers' efficacy for Education for Sustainable Development can be assessed across several areas, including values and ethics, systems thinking, emotions, and actions (Malandrakis & Stanisstreet, 2019). Karvonen and Kemi (2023) also found that self-efficacy beliefs related to teaching sustainability values and systems thinking were associated with differences in preservice teachers' perceived sustainability competency. The present instrument extends this perspective by distinguishing confidence in practicing zero-waste behaviors personally from confidence in teaching and facilitating zero-waste practices. This distinction reflects the two roles of preservice teachers as sustainability practitioners and future sustainability educators.

The inclusion of ZWB completes the framework by representing actual behavior, rather than knowledge or perceived capability alone. This is important because environmental knowledge, engagement, and behavior may develop differently depending on the educational context and available institutional support. For example, Yusuf and Fajri (2022) found differences in environmental knowledge, engagement, and waste-management behavior among university students, suggesting that these dimensions should not automatically be treated as the same. Similarly, research in Indonesian teacher education found that environmental education, environmental knowledge, and available facilities were related to preservice teachers' intentions to separate and recycle waste(Ardyanto Tanjung et al., 2024). These findings support the decision to maintain knowledge and behavior as separate components in the present instrument.

Expert judgment provided strong evidence of the content relevance of the instrument. Four experts reviewed the items in terms of relevance, construct representation, clarity, and language. Based on the relevance ratings, all 52 items obtained an I-CVI of 1.00, with an I-CVI range of 1.00–1.00 and an S-CVI/Ave of 1.00. This means that all items were considered relevant to their intended content domains by the four experts. The quantitative results are presented in Table 2.

Table 2. Content Validity and Expert Revision Results

Construct	Items	I-CVI Range	S-CVI/Ave	Accepted	Minor Revision	Major Revision	Rejected
Zero-Waste Knowledge	18	1.00–1.00	1.00	15	3	0	0
Personal Self-Efficacy	10	1.00–1.00	1.00	8	2	0	0
Instructional Self-Efficacy	12	1.00–1.00	1.00	11	1	0	0
Zero-Waste Behavior	12	1.00–1.00	1.00	10	2	0	0
Total	52	1.00–1.00	1.00	44	8		

The I-CVI and S-CVI/Ave results provide strong evidence of content relevance. I-CVI represents the proportion of experts judging an item relevant, whereas S-CVI/Ave

summarizes content validity across the scale (Polit & Beck, 2006; Polit et al., 2007). Recommended thresholds of ≥0.78 for I-CVI and approximately ≥0.90 for S-CVI/Ave provide a basis for judging adequate content validity (Polit & Owen, 2007)(Zheng et al., 2012). The present results therefore substantially exceeded these criteria.

Although all 52 items achieved complete agreement on relevance, expert comments led to minor revisions of eight items, while none required major revision or rejection. The revisions addressed distractor quality, reading load, terminology, specificity, double-barreled wording, and the distinction between observable behavior and internal processes. These revisions did not change the original constructs, dimensions, indicators, or scoring procedures. The findings show the value of combining quantitative CVI results with qualitative expert review, as numerical relevance ratings may not fully identify problems related to ambiguity, cognitive burden, or response interpretation (Polit & Owen, 2007).

The instrument also extends existing approaches to sustainability competency. Established frameworks identify competencies such as systems thinking, anticipatory, normative, strategic, and interpersonal competencies (Wiek & Redman, 2011). These frameworks were later expanded to include intrapersonal, implementation, and integration competencies (Brundiers & Zint, 2021; Redman & Barth, 2021). However, these frameworks generally address sustainability at a broad level, while sustainability competency assessment remains diverse in its operationalization (Redman et al., 2021). The present instrument applies these broader ideas to a specific and behavior-focused zero-waste context by combining objective knowledge, personal efficacy, instructional efficacy, and behavioral practice.

This integration is supported by research showing that different forms of environmental knowledge have different relationships with ecological behavior (Frick et al., 2004; Kaiser & Fuhrer, 2003). It is also consistent with evidence that environmental knowledge, engagement, and behavior are related but distinct dimensions (Rusli Yusuf & I. Fajri, 2022). Recent research among Indonesian preservice teachers found that environmental education, environmental knowledge, and available facilities were related to intentions to separate and recycle waste (Ardyanto Tanjung et al., 2024). Widayanti and Rosyidiana (2025) also showed the relevance of self-efficacy in the relationship between environmental knowledge and zero-waste behavior. The present study extends this research at the measurement level by assessing these domains together and adding Instructional Self-Efficacy as a distinct dimension for future teachers.

The distinction between Personal Self-Efficacy and Instructional Self-Efficacy is particularly important in teacher education. Self-efficacy refers to beliefs about one's ability to organize and carry out actions (Bandura, 1997), while teacher efficacy concerns teachers' beliefs about their ability to facilitate learning and influence students (Tschannen-Moran & Woolfolk Hoy, 2001). Research on Education for Sustainable Development has shown the importance of self-efficacy among preservice teachers (Malandrakis & Stanisstreet, 2019), and recent research has found that specific sustainability teaching-efficacy dimensions are related to preservice teachers' sustainability competency (Karvonen & Kemi, 2023). The present instrument extends these studies by distinguishing confidence in practicing zero-waste behavior personally from confidence in teaching and facilitating zero-waste practices.The contextualization to preservice madrasah teachers further extends existing sustainability assessment. Whereas most sustainability competency frameworks target broad higher education or teacher education contexts, the present instrument situates zero-waste competency within Islamic teacher preparation. This provides a context-sensitive framework for examining future madrasah teachers as both sustainability practitioners and educators, rather than assuming that instruments developed in general educational contexts are automatically transferable. Such contextualization is consistent with the broader call to

develop and assess sustainability competencies within specific educational settings (Cebrián et al., 2020).

The validation results show strong content validity and conceptual coherence at the development stage. All 52 items were retained, with only eight receiving minor revisions. This suggests that the initial construct specification and blueprint provided a good foundation for the instrument. At the same time, the qualitative revisions show that rigorous instrument development requires more than obtaining high numerical validity indices.

The framework also has practical implications for sustainability-oriented teacher education. Its multidimensional structure can help identify whether preservice teachers' needs are mainly related to knowledge, personal sustainable practices, or confidence in teaching sustainability. This differentiation may support more targeted interventions, such as strengthening content knowledge for ZWK and providing practice-based teaching experiences, modelling, or microteaching for ISE. This is in line with the view that sustainability competency assessment should support curriculum development rather than serve only as an endpoint measure (Brundiers & Zint, 2021; Cebrián et al., 2020).

Overall, this study contributes a contextually grounded, multidimensional framework for assessing zero-waste competency among preservice madrasah teachers. Its novelty lies not simply in developing 52 items, but in integrating knowledge, personal efficacy, instructional efficacy, and behavior within a single assessment framework. The instrument therefore addresses an identified gap in zero-waste and Islamic teacher education research. Further empirical testing is needed to establish construct validity, reliability, and the relationships among the four domains before application in high-stakes assessment or program evaluation.

D. CONCLUSION

This study addressed the need for a contextually appropriate instrument to assess zero-waste competency in Islamic teacher education by developing a multidimensional framework for preservice madrasah teachers. The framework goes beyond conventional environmental assessment, which often focuses on general environmental attitudes or self-reported behavior, by combining objective zero-waste knowledge, personal self-efficacy, instructional self-efficacy, and zero-waste behavior. The content validation process showed that the items were relevant to their intended constructs, while expert feedback helped improve the clarity and precision of several items..

The main contribution of this study is both conceptual and practical. Conceptually, the distinction between personal self-efficacy and instructional self-efficacy expands the assessment of sustainability competency from the ability to practice sustainable behavior to the ability to teach and facilitate such practices. Practically, the instrument provides a context-sensitive framework for assessing the readiness of preservice madrasah teachers to become both sustainability practitioners and educators. It can also provide a basis for evaluating sustainability-oriented teacher education programs and developing interventions related to zero-waste and Education for Sustainable Development.

However, this study focused on instrument development and content validation. Therefore, the findings do not yet provide evidence of the full psychometric properties of the instrument. Future research should test the instrument with larger and more diverse samples to examine construct validity, reliability, and its measurement performance. Further studies can also examine the relationships among zero-waste knowledge, personal self-efficacy, instructional self-efficacy, and zero-waste behavior, as well as whether the instrument can detect changes following sustainability-oriented interventions in Islamic teacher education.

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