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Measuring Environmental Awareness of Prospective Physics Teachers: Validation of an Environmental Attitude Instrument

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ABSTRACT

Understanding environmental literacy is essential for prospective physics teachers to develop responsible behaviors in responding to environmental changes. However, assessing attitudes toward the environment remains challenging due to the limitations of existing instruments. This study evaluates the feasibility of an environmental affect instrument designed for prospective physics teachers in environmental physics courses. The research employed Thiagarajan's 4D development model, which consists of four stages: define, design, develop, and disseminate. The instrument was validated by experts and users, with expert validation analyzed using Aiken's V, user validity assessed through Pearson correlation, and reliability measured using Cronbach's Alpha. Data analysis was conducted using Microsoft Excel and SPSS 16.0. The findings indicate that the developed instrument is highly valid, with an Aiken V value of 0.83 from expert validation. User validation resulted in 18 valid items and two invalid ones, while the reliability coefficient (Cronbach's Alpha) was 0.81, indicating high reliability. Consequently, 18 out of the 20 developed items are suitable for broader implementation. These findings provide a valuable tool for physics education lecturers and study programs in assessing students' environmental attitudes.

INTRODUCTION

Human behavior significantly shapes environmental quality (Puspa Widya Lubis et al., 2020). In this context, environmental education in higher education institutions is crucial for fostering environmental literacy, which helps graduates understand environmental issues and adopt responsible behaviors (Hanafi et al., 2021). As future educators, students hold a strategic position in society, where their knowledge and perspectives can influence public discourse and drive collective environmental action (Cahyono, 2019; Houari et al., 2024; Mazumdar, 2022). Environmental literacy equips individuals with the knowledge, skills, and attitudes to address environmental challenges and promote sustainability. This framework is widely incorporated into Education for Sustainable Development (ESD) to cultivate environmentally responsible citizens (Fetiana et al., 2022).

The Environmental Literacy Task Force (2015) defines an environmentally literate individual as someone capable of taking individual and collective action to protect the environment, support economic sustainability, and build resilient communities (Clayton et al., 2019). Environmental literacy comprises three key components—knowledge, awareness, and behavior—which interact significantly (Tian & Chen, 2023). The affective dimension of environmental literacy, which encompasses

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attitudes, emotions, and values, is crucial in shaping environmental responsibility. Attitudes toward the environment often serve as precursors to action, influencing an individual's sustainability efforts (Cañas & Zoleta, 2024; Cohen et al., 2021). However, inconsistencies between attitudes and behaviors frequently arise due to external factors affecting decision-making processes (Jumriani et al., 2021). Hollweg identifies key elements of environmental attitudes, including sensitivity, concern, worldview, personal responsibility, self-efficacy, motivation, and intentions (Čapienė et al., 2022).

Despite the importance of environmental attitudes, limited research has explored standardized instruments for assessing them, particularly among prospective physics teachers. Observations at the university level suggest that no established tool currently measures the environmental attitudes of future educators, even though environmental topics are integrated into physics education curricula. Environmental physics courses provide students with opportunities to develop sustainability awareness and understand environmental phenomena, making it essential to measure their affective responses to these topics (Suyanto et al., 2024). Thus, there is a pressing need for an instrument to assess environmental attitudes in students training to become physics teachers.

Research instruments play a vital role in systematically collecting data and improving the accuracy and effectiveness of scholarly investigations (Hakimah, 2016; Mulyana & Desnita, 2023). Attitude assessment tools are particularly important for prospective physics teachers, as field studies indicate that educators often struggle to evaluate students' attitudes (Ragae et al., 2022; A. G. C. Wicaksono & Korom, 2023; T. P. Wicaksono et al., 2016). Findings from the National Environmental Literacy Assessment (NELA) reveal that students' environmental behavior generally falls within the "moderate" category (Hidayah & Agustin, 2017; Svobodová & Chvál, 2022).

Existing research has examined various aspects of environmental literacy assessment, including initiatives to establish eco-schools (Parida et al., 2021), enhance teachers' environmental knowledge (Szczytko et al., 2019), and integrate spiritual-based environmental literacy into science education (Husamah et al., 2023). Additionally, several studies have utilized models, such as ADDIE, for competency assessment (Pramana et al., 2022) and factor analysis for validation (Szczytko et al., 2019). However, most research has focused on knowledge-based environmental literacy rather than affective dimensions. The absence of an environmental affect instrument specifically designed for prospective physics teachers represents a significant gap in assessing students' attitudes and behavioral tendencies toward environmental issues.

Building on prior research, this study aims to develop and validate an environmental affect instrument tailored for prospective physics teachers in environmental physics courses. Unlike previous studies, which primarily focus on general environmental literacy, this research emphasizes the affective domain. It employs the 4D development model (Thiagarajan, 1974) and utilizes a distinct validation methodology, including Aiken's V analysis for expert validation and Pearson correlation for user validity. By addressing the need for a standardized tool to assess environmental attitudes among future educators, this study contributes to curriculum development and improves assessment practices in environmental physics courses.

METHODS

This study employs the Research and Development (R&D) method, utilizing the 4D model developed by S. Thiagarajan, Dorothy S. Semmel, and Melvyn I. Semmel in 1974. The 4D model was chosen for its systematic approach to developing educational instruments, ensuring theoretical rigor and practical applicability. Compared to other instructional design models, it offers a structured yet flexible framework that supports iterative validation and refinement. This makes it particularly effective for developing psychometric instruments. The 4D model consists of four stages, as illustrated in Figure 1.

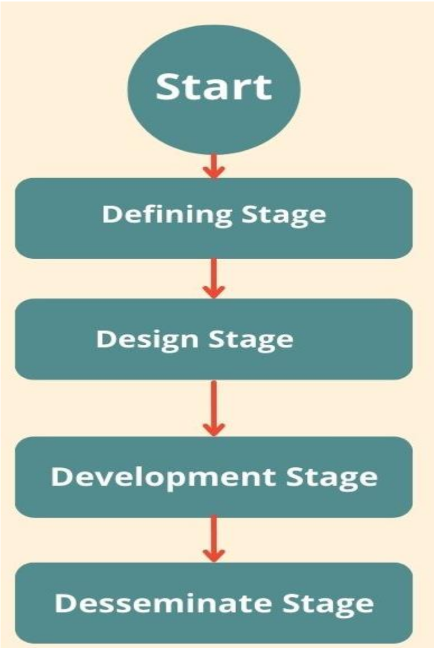

Figure 1. Research Flowchart

The research activities conducted at each stage are as follows:

1. Defining Stage

This stage involved establishing and defining objectives to develop the environmental affect instrument requirements. The process included end-start analysis, observation result analysis, task analysis, concept analysis, and determining goal instructions.

2. Design Stage

In this stage, the research focused on determining behavioral objectives and selecting the appropriate format and media for the initial design of teaching tools. This included developing test criteria, selecting fonts, and determining various formats such as instructional guides, resource management strategies, material mastery guidelines, multimedia tools, and instrument formats that were easy to understand.

3. Development Stage

During the development stage, the instrument underwent a series of formative evaluations. First, an expert review was conducted using structured validation sheets, where experts assessed item clarity, relevance, and alignment with environmental literacy constructs. Following this, a small-scale user trial was conducted with a subset of students, allowing for iterative refinements based on real-user feedback.

4. Dissemination Stage

The dissemination stage involved the validated instrument's final evaluation, product refinement, and distribution. The final version underwent empirical validation before broader implementation. The dissemination process was conducted systematically to ensure the instrument met the expected standards of validity and reliability.

The instrument development process included validation by both experts and users. Expert validation was conducted by three faculty members specializing in education and environmental sciences. Meanwhile, user validation involved 28 students enrolled in the Environmental Physics course at the Faculty of Education and Teacher Training, State Islamic University of Ar-Raniry Banda Aceh. These students were selected because they had prior instruction on environmental issues, making them suitable participants for evaluating the instrument's applicability.

The validation process followed these steps:

1. Three lecturers in relevant fields did expert validation.
2. User validation involved 28 students.
3. The validation results were analyzed to determine the instrument's strengths and weaknesses.
4. Decision-making was based on validation outcomes.
5. The revision of the instrument was done to address identified weaknesses.

The validation scores obtained from expert and user evaluations were analyzed using Aiken's V formula to determine content validity. The possible range of V values is between 0.00 and 1.00 (Risamasu et al., 2023), mathematically expressed as:

$$V = \frac{\sum s}{n\,(c-1)}$$

The formula contains s to represent the score given by each expert, n to represent the number of experts, and c to represent the highest rating scale.

Statistical analyses were conducted using SPSS version 16.0 to assess the validity and reliability of the instrument. A significance level of 0.05 was applied to determine the statistical validity and reliability of the results. The findings from these analyses confirmed that the developed instrument was both statistically robust and practically applicable in assessing environmental affect among prospective physics teachers.

RESULTS AND DISCUSSION

Based on the review of instrument development using Thiagarajan's development steps, the process followed these stages:

1. The Define Stage

This stage began with the definition phase, which included an initial analysis, observation, task analysis, and concept analysis. The results from these analyses indicated that no instrument had been developed to measure environmental attitudes in the Physics Education Program at the Faculty of Education and Teacher Training, State Islamic University of Ar-Raniry, Banda Aceh. Therefore, questions were formulated based on the relevant indicators to ensure alignment with the curriculum's expectations and the characteristics of its users. As a result, the developed instrument aimed to assess students' attitudes in the environmental physics course. The instrument was designed to be valid and reliable to ensure its effectiveness.

2. The Design Stage

This stage involved developing test criteria by creating 20 attitude scale questions aligned with the instrument's framework. The test format was structured as statements, and a rating scale was designed based on Likert scale criteria. Additionally, the researcher prepared the instrument validation sheet and guidelines for its use and evaluation to facilitate clarity and ease of assessment.

3. The Development Stage

During this stage, the researcher developed the environmental affect instrument to assess its effectiveness in measuring environmental attitudes. The final version of the instrument was refined based on formative evaluation feedback from experts and pilot testing with students.

1) Expert Validity

The results included expert validation of the instrument's indicator aspects used in this study, calculated using Aiken's V formula. Figure 1 presents the obtained Aiken's V values for reference.

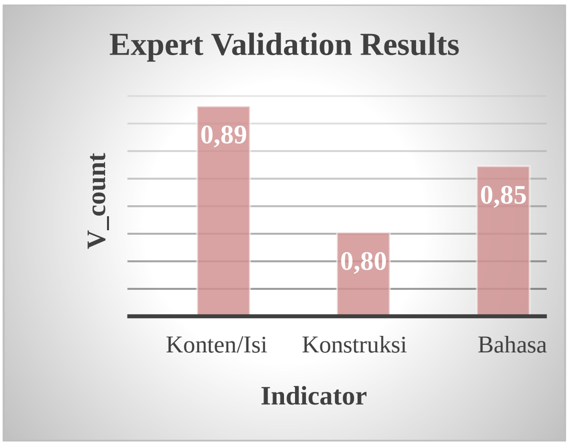

Figure 1. Expert Validation Results Based on Instrument Development Indicators.

2) Empirical Validity by Users

Next, 18 questions were deemed valid. The questions were tested for reliability using Cronbach's Alpha, assisted by the

SPSS 16.0 version. The results are presented in Table 1.

Table 1. Reliability Statistics

Cronbach's Alpha	N of Items
0.810	18

4. The Dissemination Stage

This stage aimed to assess the success of the development process and ensure that the outcomes aligned with expert evaluators' recommendations. The activities included the final evaluation, preparation of the final product, and dissemination. The dissemination process occurred after the final evaluation, during which the developer empirically validated the results.

As shown in Figure 1, the content or construct indicators received a value of 0.89, indicating a very high level of validity. This result aligned with the feedback from validators, who confirmed that the question statement forms matched the indicators, ensuring content accuracy. A formal content validity analysis, categorized as very high, played a crucial role in evaluating the instrument's items concerning the target construct.

Content validation enhanced the quality of data collection, measurement, and analysis, ultimately leading to more reliable and valid results across various fields of study. Formal Content Validity Analysis (FCVA) and Bayesian FCVA improved evaluation precision without requiring excessive effort, strengthening the instrument's content validity assessment (Spoto et al., 2023). Validating content ensures the accuracy and relevance of research instruments (Nordin et al., 2022). The content validity of this instrument aligned with the concept of environmental affect.

As shown in Figure 1, the construct indicators received a value of 0.80, which fell into the high validity category. This result was supported by input from three validators, two of whom suggested improvements in the wording of the questions. Ensuring construct validity was essential for the credibility and effectiveness of non-test instruments in measuring various phenomena and traits. Construct validity involves accurately assessing phenomena based on a defined theoretical framework (Heller et al., 2022; Mirabal, 2020). An instrument achieves construct validity by effectively measuring specific phenomena or traits according to predefined criteria.

Construct validity can be assessed by examining the instrument's correlation with other variables theoretically related to the construct being measured (Jun Rong Jeffrey Neo, 2017; Kassab et al., 2020). This process involves analyzing relationships among items, domains, and concepts to ensure they align with predefined theoretical expectations (Martínez-Corona et al., 2020; Stenner et al., 2023). Construct validity reflects an instrument's internal rationality, determining how well it captures the intended theoretical concept.

As shown in Figure 1, the calculated validity score for language indicators is 0.85, indicating a high level of validity. Validators have suggested modifications to certain word placements, aligning with empirical test results. Expert validation is crucial in instrument development, ensuring semantic accuracy, linguistic appropriateness, and cultural relevance across diverse populations (Efstathiou, 2019; Istyarini et al., 2021; Von Steinbuechel et al., 2021). Engaging language experts in this process enhances research instruments' quality and cross-cultural applicability.

The validation metrics in Figure 1 correspond to the 20-item instrument designed to assess environmental affect. A thorough evaluation of content, construct validity, and linguistic clarity confirms the instrument's accuracy, reliability, and strong alignment with its theoretical framework. This reinforces its effectiveness in measuring students' perspectives on environmental issues.

Validity testing is essential for determining an instrument's accuracy. A highly valid instrument minimizes measurement errors, ensuring that obtained scores closely reflect true values. Techniques such as the Delphi method, expert content validation, and statistical analyses—including Cronbach's Alpha and Exploratory Factor Analysis—help establish internal consistency, construct validity, and overall reliability. Validated indicators facilitate the development of precise measurement tools, leading to more reliable data and informed decision-making. Additionally, standardizing measurement procedures enhances the consistency and comparability of data across different studies and populations.

Different methods assess validity, including content validity, construct validity, and criterion validity (Ansari & Khan, 2023). Content validity requires expert judgment to confirm whether an instrument adequately represents the content domain. Construct validity examines how well theoretical concepts translate into measurable variables (Ansari & Khan, 2023; Purba et al., 2022). Criterion validity, assessed through concurrent and predictive approaches, measures an instrument's accuracy (Ansari & Khan, 2023; Yusup, 2018). Importantly, validity is not an inherent property of the test itself but lies in interpreting and applying its scores (Bandemci, 2022). This underscores the critical role of experts in verifying content and constructing accuracy. Figure 2 presents the results of the Environmental Affect instrument's validation, as assessed by users.

Figure 2. The Percentage of Validation Results by Users

Figure 2 illustrates the percentage distribution of the developed statement items based on their validity levels. Notably, 0% of the statements fall into the very high validity category, indicating that no statements were classified in this range. In the high validity category, 10% of the statements, or 2 items, are deemed valid. The medium and low validity categories contain 40% of the statements each, with 8 statements in each category. The low validity category holds 10% of the statements, or 2 items, which are considered unsuitable for broad testing.

Of the 20 developed statements, 90% are deemed appropriate for measuring Environmental Affect, while 10% are unsuitable. Based on user testing, it has been concluded that 18 questions will proceed to reliability testing, while 2 statements will be discarded. This highlights the critical role of user validation in instrument development.

User validation is essential for ensuring the reliability and effectiveness of instruments designed to measure environmental attitudes (Nikhat & Khan, 2017; Retnowati et al., 2020; Uzun et al., 2019). Factors such as education and age significantly influence individual attitudes toward environmental protection, while income and job prestige scores do not impact environmental attitudes in American society (Pawel Rydzewski, 2017). User validation significantly enhances the quality and reliability of instruments that measure environmental attitudes.

Engaging users in the development process enhances the quality of the instrument, ensuring that items are relevant, clear, unambiguous, easy to answer, non-judgmental, and non-distressing. This, in turn, improves the validity and content sensitivity of the instrument (Connell et al., 2018). Moreover, user validation is crucial for accurately measuring complex constructs like multilingualism and student identity (Haukås et al., 2021). It is also vital for ensuring that the instrument is culturally appropriate and psychometrically sound, which is confirmed through the validation process, which includes assessing reliability, validity, sensitivity, and feasibility in both clinical practice and research (Carvajal et al., 2011; Shin & Lee, 2024).

The validation process includes several steps: designing the instrument, expert content validation, pilot testing, data correction, and verification of question consistency. These steps all aim to enhance the instrument's reliability and validity. Through validation, researchers can establish confidence in the data collected, ensuring the instrument measures what it intends to measure. Ultimately, a validated instrument strengthens the credibility and quality of research, allowing researchers to draw accurate conclusions and make informed, data-driven decisions.

The reliability test results presented in Table 1 show that the 18 validated questions yielded a Cronbach's Alpha of 0.81, indicating very high reliability. This suggests that the instrument provides consistent results across different time points and user groups, confirming its suitability for measuring environmental affect.

Test reliability is critical during the design and development stages to ensure the product's dependability and the quality and durability of the developed structure (Sun et al., 2024). Reliability testing is necessary to accurately assess the likelihood of failure and ensure the developed structure's performance (Wang, 2022). Therefore, the 18 validated questions are appropriate for broader application and dissemination.

CONCLUSION AND SUGGESTION

The feasibility results are based on expert assessments of the validity levels, where the developed environmental affect instrument demonstrated very high validity across three aspects: Content/Information, Construction, and Language. The computed validity coefficient (V) was 0.83. However, user validation identified items 8 and 19 as invalid due to their Corrected Item-Total Correlation being below 0.20. As a result, 18 items were deemed valid. Reliability testing showed a Cronbach's Alpha of 0.81, indicating high reliability. Therefore, the 18 valid items with these reliability results are suitable for dissemination and broader use.

Further investigation has underscored the need for more comprehensive pilot testing. Although the initial pilot study involved one class of students, there is potential for expansion by including users from various educational levels or institutions. This approach will help further validate the assessment tool and ensure its effectiveness across a diverse user population.

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AUTHOR CONTRIBUTIONS

S contributed to drafting the manuscript, developing research materials, and analyzing the findings. ZKP and M were responsible for developing the research ideas and design. FH contributed to data collection and processing.

REFERENCES

Ansari, M. M., & Khan, S. (2023). An In-depth Examination of Validity Assessment: Exploring Diverse Methodologies and Dimensions of Validity in Social Research Studies. *Asian Journal of Agricultural Extension, Economics & Sociology*, *41*(10), 772–782. https://doi.org/10.9734/ajaees/2023/v41i102224

Bandemci, V. (2022). Correcting Fallacies about Validity as the Most Fundamental Concept in Educational and Psychological Measurement. *International E-Journal of Educational Studies*, *6*(12), 148–154. https://doi.org/10.31458/iejes.1140672

Cahyono, H. (2019). Peran Mahasiswa di Masyarakat. *Jurnal Pengabdian*

Masyarakat Setiabudhi, *1*(1), 32–43. https://doi.org/10.4000/adlfi.2398

Cañas, R. J. C., & Zoleta, J. M. (2024). Investigation of Environmental Attitudes: Implications to Sustainable Campus Waste Management. *American Journal of Environment and Climate*, *3*(2), 25–33. https://doi.org/10.54536/ajec.v3i2.2788

Čapienė, A., Rūtelionė, A., & Krukowski, K. (2022). Engaging in Sustainable Consumption: Exploring the Influence of Environmental Attitudes, Values, Personal Norms, and Perceived Responsibility. *Sustainability (Switzerland)*, *14*(16), 10290–10290. https://doi.org/10.3390/su141610290

Carvajal, A., Centeno, C., Watson, R., Martínez, M., & Rubiales, A. S. (2011). How is an instrument for measuring health to be validated? *Anales Del Sistema Sanitario de Navarra*, *34*(1), 63–72.

Clayton, S., Bexell, S. M., Xu, P., Tang, Y. F., Li, W. J., & Chen, L. (2019). Environmental literacy and nature experience in Chengdu, China. *Environmental Education Research*, *25*(7), 1105–1118. https://doi.org/10.1080/13504622.2019.1569207

Cohen, D., Shin, F., & Lawless, R. M. (2021). Attitudes, Behavior, and Institutional Inversion: The Case of Debt. *Journal of Personality and Social Psychology*, *120*(5), 1117–1145. https://doi.org/doi: 10.1037/PSPA0000265

Connell, J., Carlton, J., Grundy, A., Taylor Buck, E., Keetharuth, A. D., Ricketts, T., Barkham, M., Robotham, D., Rose, D., & Brazier, J. (2018). The importance of content and face validity in instrument development: lessons learnt from service users when developing the Recovering Quality of Life measure (ReQoL). *Quality of Life Research*, *27*(7), 1893–1902. https://doi.org/10.1007/s11136-018-1847-y

Dissanayake, D. M. S. B. (2023). Connecting the Dots; Environmental Literacy Index in Measuring Knowledge for Environmental Conservation. *Proceedings of the 27th International Forestry and Environment Symposium*, *27*, 155. https://doi.org/10.31357/fesympo.v27.7189

Efstathiou, G. (2019). *Translation, Adaptation and Validation Process of Research Instruments*. Springer, Cham. https://doi.org/https://doi.org/10.1007/978-3-319-89899-5_7

Fang, W.-T., Hassan, A., & LePage, B. A. (2023). The Living Environmental Education: Sound Science Toward a Cleaner, Safer, and Healthier Future. In *Sustainable Development Goals Series*. Springer Nature Singapore. https://doi.org/10.1007/978-981-19-4234-1

Fetiana, N., Permanasari, A., & Permana, I. (2022). Environmental Literacy of Junior High School Students in Bogor: Contribution of Knowledge to Environmental Attitudes and Behaviors. *Jurnal Penelitian Pendidikan IPA*, *8*(5), 2423–2429. https://doi.org/10.29303/jppipa.v8i5.1794

Hakimah, E. N. (2016). Pengaruh Kesadaran Merek, Persepsi Kualitas, Asosiasi Merek, Loyalitas Merek Terhadap Keputusan Pembelian Makanan Khas Daerah Kediri Tahu Merek "POO" Pada Pengunjung Toko Pusat Oleh-Oleh Kota Kediri. *Jurnal Nusantara Aplikasi Manajemen Bisnis*, *1*(1), 13–21.

Hanafi, Y., Aprilia, N., Nurusman, A. A., Purwanto, A., Nadiroh, N., & Budi, S. (2021). Analisis Kebutuhan Pengembangan Instrumen Literasi Lingkungan Untuk Mahasiswa Pendidikan Biologi FKIP Universitas Ahmad Dahlan. *Jurnal Eksakta Pendidikan (Jep)*, *5*(2), 174–180. https://doi.org/10.24036/jep/vol5-

iss2/604

Haukås, Å., Storto, A., & Tiurikova, I. (2021). Developing and validating a questionnaire on young learners' multilingualism and multilingual identity. *Language Learning Journal*, *49*(4), 404–419. https://doi.org/10.1080/09571736.2021.1915367

Heller, H. M., Draisma, S., & Honig, A. (2022). Construct Validity and Responsiveness of Instruments Measuring Depression and Anxiety in Pregnancy: A Comparison of EPDS, HADS-A and CES-D. *International Journal of Environmental Research and Public Health*, *19*(13). https://doi.org/10.3390/ijerph19137563

Hidayah, N., & Agustin, R. R. (2017). Assessing High School Students' Pro-Environmental Behaviour. *Journal of Physics: Conference Series*, *895*(1), 012002. https://doi.org/10.1088/1742-6596/895/1/012002

Houari, B., Elhachemi, H., & Baffa, A. (2024). Role of the University in Developing Educational Implications in Society. *International Journal of Health Sciences*, *8*(S1), 16–28. https://doi.org/10.53730/ijhs.v8ns1.14695

Husamah, H., Rahardjanto, A., Hadi, S., Lestari, N., & Ummah BK, M. K. (2023). Spirituality-based environmental literacy among prospective biology teacher in Indonesia: Analysis based on gender, accreditation, and semester-level aspects. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *9*(3), 418–432. https://doi.org/10.22219/jpbi.v9i3.29500

Istyarini, Wahzudik, N., Wardi, Nurussa'adah, & Christian. (2021). Validation of reflective model curriculum evaluation instruments. *Proceedings of the International Conference on Industrial Engineering and Operations Management*, 3430–3437. https://doi.org/10.46254/sa02.20210953

Jumriani, Ilmiyannor, M., & Mi'rajiatinnor, D. (2021). Strengthening Environmental Care Attitudes Through Social Wisdom-Based Social Studies Learning. *Proceedings of the 2nd International Conference on Social Sciences Education (ICSSE 2020)*, *525*, 65–69. https://doi.org/10.2991/assehr.k.210222.009

Jun Rong Jeffrey Neo. (2017). Construct Validity—Current Issues and Recommendations for Future Hand Hygiene Research. *American Journal of Infection Control*, *45*(5), 521–527. https://doi.org/https://doi.org/10.1016/j.ajic.2017.01.028

Kassab, S. E., Bidmos, M., Nomikos, M., Daher-Nashif, S., Kane, T., Sarangi, S., & Abu-Hijleh, M. (2020). Construct Validity of an Instrument for Assessment of Re fl ective Writing-Based Portfolios of Medical Students. *Advances in Medical Education and Practice*, *11*, 397–404.

Martínez-Corona, J. I., Palacios-Almón, G. E., & Juárez-Hernández, L. G. (2020). Análisis de validez de constructo del instrumento : " Enfoque Directivo en la Gestión para Resultados en la Sociedad del Conocimiento ." *Retos*, *10*(19), 153–165.

Mazumdar, S. (2022). Education And Society: Role Of Schools In Influencing The Mechanisms Of Societal Structure. *Towards Excellence*, *14*(3).

Mirabal, H. T. (2020). Observaciones para la construcción y validación de instrumentos de investigación Observations for Construction and Validation of Research. *Desafíos*, *11*(2), 70–83.

Mulyana, V., & Desnita, D. (2023). Validity and Practicality of Scientific Literacy Assessment Instruments Based on Tornado Physics Enrichment Book.

Jurnal Ilmiah Pendidikan Fisika Al-Biruni, *12*(1), 11. https://doi.org/10.24042/jipfalbiruni.v12i1.15934

Nikhat, & Khan, Z. N. (2017). Construction and Validation of Environmental Ethics Attitude Scale. *IRA-International Journal of Education & Multidisciplinary Studies*, *07*(03), 240–249. https://doi.org/DOI: http://dx.doi.org/10.21013/jems.v7.n3.p9 How

Nordin, M. R., Jamal, S. A., & Anuar, N. A. M. (2022). Content validity of research instruments: assessing domestic ecotourism in protected areas. *ENLIGHTENING TOURISM. A PATHMAKING*, *12*(2), 565–599.

Parida, L., Kurniati, A., Dike, D., Persada, S., & Sintan, K. (2021). Pengembangan Literasi Lingkugan Sekolah Berbasis Kolaborasi Stake Holder Sebagai Piloting Project Di Sekolah Dasar. *Jurnal Pengabdian Masarakat Pendidikan Dasar*, *1*(2), 6–12.

Pawel Rydzewski. (2017). General Social Survey and Sustainable Development. Methodological and General Social. *Problemy Ekorozwoju-Problems of Sustainable Development*, *12*(1), 21–29.

Pramana, I. P. A. A., Putrayasa, I. ., & Sanjaya, D. B. (2022). Pengembangan Instrumen Sikap Peduli Lingkungan dan Kompetensi Pengetahuan IPA Siswa Kelas IV SD. *PENDASI: Jurnal Pendidikan Dasar Indonesia*, *6*(1), 33–44.

Purba, Y. O., Fadhilaturrahmi, Purba, J. T., & Siahaan, K. W. A. (2022). *Teknik Uji Instrumen Penelitian Pendidikan* (A. Masruroh (ed.); Issue February). Widina Bhakti Persada Bandung.

Puspa Widya Lubis, S., Rahmiza Muzanna, S., Firdausiyah, I., Biologi, P., Abulyatama, U., Blang Bintang Lama Km, J., Keude Aceh Besar, L., & Fisika, P. (2020). Profil Sikap Peduli Lingkungan Siswa SMA Di Aceh. *Jurnal Dedikasi Pendidikan*, *4*(1), 34–42.

Ragae, D., Tulu, A., & Mekonnen, G. T. (2022). The Nexus between Prospective Teachers' Attitude towards Teaching Profession, Department Placement, and Their Academic Achievement in Ethiopia. *Universal Journal of Educational Research*, *10*(9), 513–522. https://doi.org/10.13189/ujer.2022.100901

Retnowati, R., Awaludin, M. T., & Heryawati, E. R. (2020). Developing an integrated biology module for students ' environmental attitude instruments. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *6*(2), 327–334.

Risamasu, P. V. M., Pieter, J., & Gunada, I. W. (2023). Pengembangan Bahan Ajar IPA SMP Tema Perpindahan Kalor Berkonteks Etnosains Jayapura Papua. *Jurnal Ilmiah Profesi Pendidikan*, *8*(1b), 948–958. https://doi.org/10.29303/jipp.v8i1b.1322

Shin, S., & Lee, E.-H. (2024). Development and validation of a healthy work environment quality instrument. *Research Square*, 1–17.

Singleton. (2015). Environmental Literacy And Sustainability Values: A Content Analysis Of Environmental Education Standards. *Ecological Integrity*, *1*.

Spoto, A., Nucci, M., Prunetti, E., & Vicovaro, M. (2023). Improving content validity evaluation of assessment instruments through formal content validity analysis. *Psychological Methods*. https://doi.org/https://doi.org/10.1037/met0000545

Stenner, A. J., Iii, M. S., & Burdick, D. S. (2023). Explanatory Models, Unit Standards, and Personalized Learning in Educational Measurement. In *Explanatory Models, Unit Standards, and Personalized Learning in Educational Measurement*. Springer Nature Singapore. https://doi.org/10.1007/978-981-19-

3747-7

Sun, Y., Li, L., & Tiniakov, D. (2024). Reliability Tests. In: Reliability Engineering. In *Reliability Tests*. Springer. https://doi.org/https://doi.org/10.1007/978-981-99-5978-5_8

Suyanto, E., Suyatna, A., Destryati, A., & Pratama, A. (2024). *Ethnoscience-based E-worksheet to Stimulate Science Process Skills*. *13*(1), 11–21. https://doi.org/10.24042/jipfalbiruni.v13i1.14408

Svobodová, S. (2023). Environmental Literacy Of Isced 2 Pupils In Poland Silvie. *Jounal of Elementary Education*, *16*(1), 59–77.

Svobodová, S., & Chvál, M. (2022). Environmental Literacy of Lower Secondary School Pupils in the Czech Republic. *Journal of Biological Education*, *86*(2), 383–405. https://doi.org/doi.org/10.1080/00219266.2022.2067213

Szczytko, R., Stevenson, K., Peterson, M. N., Nietfeld, J., & Strnad, R. L. (2019). Development and Validation of the Environmental Literacy Instrument for Adolescents. *Environmental Education Research*, *25*(2), 193–210. https://doi.org/10.1080/13504622.2018.1487035

Thiagarajan, S. (1974). *Instructional development for training teachers of exceptional children : A source book*. University of Minnesota.

Tian, H., & Chen, S. (2023). Structural Analysis of Environmental Literacy of Urban Residents in China—Based on the Questionnaire Survey of Qingdao Residents. *Sustainability (Switzerland)*, *15*(6). https://doi.org/10.3390/su15065552

Uzun, N., Gilbertson, K. L., Keles, O., & Ratinen, I. (2019). Environmental Attitude Scale for Secondary School, High School and Undergraduate Students: Validity and Reliability Study. *Journal of Education in Science Environment and Health*, *5*(1), 79–90. https://doi.org/10.21891/jeseh.491259

Von Steinbuechel, N., Rauen, K., Krenz, U., Wu, Y. J., Covic, A., Plass, A. M., Cunitz, K., Mueller, I., Bockhop, F., Polinder, S., Wilson, L., Steyerberg, E. W., Maas, A. I. R., Menon, D., & Zeldovich, M. (2021). Translation and Linguistic Validation of Outcome Instruments for Traumatic Brain Injury Research and Clinical Practice: A Step-by-Step Approach within the Observational CENTER-TBI Study. *Journal of Clinical Medicine*, *10*(13), 1–31. https://doi.org/10.3390/jcm10132863

Wang, L. (2022). Research Methods for Reliability Analysis of Engineering Structures Based on Statistical Theory. *Highlights in Science, Engineering and Technology*, *28*, 94–100. https://doi.org/10.54097/hset.v28i.4066

Wicaksono, A. G. C., & Korom, E. (2023). Attitudes Towards Science in Higher Education: Validation of Questionnaire Among Science Teacher Candidates and Engineering Students in Indonesia. *Heliyon*, *9*(9). https://doi.org/10.1016/j.heliyon.2023.e20023

Wicaksono, T. P., Muhardjito, & Harsiati, T. (2016). Pengembangan Penilaian Sikap dengan Teknik Obserasi, Self Assessment, dan Peer Assessment pada Pembelajaran Tematik Kelas V SD Arjowinangun 02 Malang. *Jurnal Pendidikan*, *1*(1), 45–51.

Yusup, F. (2018). Uji Validitas Dan Reliabilitas Instrumen Penelitian Kuantitatif. *Jurnal Ilmiah Kependidikan*, *7*(1), 17–23. https://doi.org/10.21831/jorpres.v13i1.12884.