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Translation and validation of student attitude assessment instrument towards science learning

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ABSTRACT

Adapting research instruments presents challenges, as incorrect adaptation can affect the validity and reliability of the measurement. The study aims to adapt an instrument that is available in different languages. The adapted instrument is designed to assess students' attitudes towards science learning in the classroom. The use of adapted research instruments with other cultures or across cultures affects the results obtained. The method used is back-end translation, followed by a pilot test of the translated instrument with respondents. Back-end translation was performed by translating the original instrument from English to Indonesian. The pilot test was conducted on 85 high school students. The instrument is considered equivalent if there are similarities or if the results of the validity and reliability tests are not significantly different from those of the original instrument. The results of the analysis of the adapted instrument show that it is valid and reliable. Compared with the original instrument, the instrument yielded results similar to those of the original version. These results suggest that the instrument is both equivalent and suitable for assessing students' attitudes towards science learning. The instrument adaptation method can be considered successful.

Keywords: validation, research instruments, students attitude, science learning

1. INTRODUCTION

Science learning improves when teachers understand the importance of the psychological development behind students' character and actions. This can be achieved by understanding students' attitudes toward and during the learning process. In other words, teachers should not only focus on students' skills and knowledge but also their attitudes or affective states (emotions and values) in the classroom. Therefore, learning needs to consider students' attitudinal or affective components (Syed Hassan 2018). A common problem in the attitudinal component is students' interest and motivation in classroom learning. It is well known that student interest and motivation significantly influence the achievement of learning objectives (Primastami et al. 2024; Prastyo et al. 2024). This problem has prompted researchers to identify students' interests and motivations in learning specific subjects.

However, before understanding student attitudes, which directly influence the achievement of classroom learning objectives, a thorough review of the instruments used to assess or measure them is necessary. Instruments used to assess student attitudes must be valid and reliable to produce sound assessments. Methods for assessing student attitudes can be implemented by developing a custom instrument from scratch or adapting an existing instrument. Both methods have their own advantages and disadvantages. Developing an instrument from scratch requires a considerable amount of time, as it involves synthesizing various literature to serve as a guideline for instrument development. Adapting an instrument, on the other hand, has the advantage of being immediately usable, thus minimising the time required for assessment. Furthermore, the adapted instruments have undergone validity and reliability testing, proving their suitability for use in assessments. However, adapting instruments across cultures presents challenges such as language differences. Poorly constructed adaptations of research instruments can impact the validity and reliability of the assessment (Sperber et al. 1994). Translating an instrument from one language to another also impacts its validity. This is because there is a potential for differing interpretations after translation. Translating instruments directly raises concerns regarding the accuracy of the obtained data. Simply translating from English to another language is insufficient to account for linguistic and cultural differences in meaning. Therefore, adapting research instruments cannot be done simply by translating them directly into another language for use; appropriate methods for testing the adapted instruments are necessary.

A strategy for adapting cross-cultural research instruments is to increase the equivalence of the adapted research instruments. This strategy is implemented by one-way translation and back-end translation. One-way translation only translates the instrument from one language to another. In contrast, back-end translation translates back and forth from the original language to the other language and then from the other language to the original language. Therefore, one-way translation can result in low instrument validity and reliability. Another method, back-end translation, requires at least two independent translators. For example, the first translator translates the instrument from the original language into the desired language, and then the second translator translates it back into the original language. Another study employed a method of simultaneous translation by two independent translators. Subsequently, two other translators, who were not involved in the initial translation, back-translated the instrument into the original language of the instrument (Shohani et al. 2020).

The second stage involved conducting instrument equivalence testing. The strategy for testing the equivalence of research instruments involved pilot testing the instruments with respondents. Furthermore, the more rigorous and inclusive the translation process, the more it supports equivalence, encompassing aspects such as translator selection, format selection, expert review, and response comparison. Equivalence can also be tested by comparing the validity and reliability of the adapted and original instruments. If there are similarities or test results that are not significantly different, the instruments can be considered to be equivalent. The internal consistency coefficients can be compared. An adapted instrument can be considered equivalent if the internal consistency coefficient (alpha) is not significantly different from the original instrument (Hilton et al. 2002). Kristjansson et al. (2003) recommended several steps to be considered in the process of translating and adapting an instrument, namely: (1) verifying the concept of the measurement instrument, (2) translating the instrument and developing the preliminary

version, (3) committee review and evaluation of the preliminary version, (4) pre-testing the instrument, and (4) pilot testing the instrument.

2. METHOD

This descriptive study presents the results of adapting research instruments to measure students' attitudes towards learning in the classroom. The study was conducted over two weeks. The population consisted of seventh to 10th–grade students at Senior High School Permata Kasih and Junior High School Sinar Kasih in Melawi Regency. The research subjects consisted of 85 students who had learned science. Therefore, students from the 11th to 12th grades were not included in the study. This study began with the translation of an adapted instrument into Portuguese. This study adapted an instrument from Hilton et al. (2002) in English, which included 20 items designed to assess students' attitudes toward science learning. Therefore, it must be translated into Indonesian, which requires a translator proficient in English. The translation strategy employed was back-end translation, as it is considered superior to one-way translation (Hilton et al. 2002). The scale has five subscales: learning environment (5 items), student engagement (favorable attitude) (3 items), cognitive (career interest) (4 items), well-being (4 items), and behavior (scientific inquiry through ICT) (4 items). The researcher employed two independent translators with expertise in English, specifically a bachelor's degree holder in English Literature and a bachelor's degree holder in English Education. The first translation was carried out by a translator with an English Literature background who translated the original version of the instrument into Indonesian. The second translation was performed by a translator with an English education. The results of these translations were compared to determine the level of agreement in understanding between the two translators. Next, the researcher conducted a pilot test of the instrument on students to determine its equivalence. The pilot test results were analyzed for validity and reliability. If the validity and reliability results of the original instrument are similar to those of the translated instrument, the adapted instrument is considered relevant.

3. RESULT AND DISCUSSION

The translation results were analyzed using the back-end translation strategy by comparing the Indonesian translation with the English back-translation and analyzing words that were difficult to translate into Indonesian. Subsequently, validity and reliability tests were performed on the questionnaire, which had been adapted into Indonesian. Suppose the results of the validation and reliability tests are not significantly different from the validity and reliability tests of the original instrument. In this case, it can be concluded that the adapted instrument is equivalent to the original instrument.

3.1 Back-End Translation Results

The first translator translated the original English version of the instrument into Indonesian. The second translator then translated the first translator's translation (in Indonesian) back into English. The second translator did not see the original version of the adapted research instruments. The results indicated that some statements were clear, but others required revision in their wording. The results of the questionnaire instrument translation indicated that all translated statements were clear; however, some statements required revision. For example, statement number 11, "I discover new things in the science class" which is retranslated to "I found the new things in the science class project". Some statements use different words but are considered synonyms of the original version of the statement such as: the original version uses the word "discover" the retranslated version uses the word "found", the original version uses the word "learn" the retranslated version uses the word "study" There are statements that are difficult to translate such as "I want to study in the science stream for form four and five" the translation result "I want to study in the science stream for 4 or 5 forms". This statement is unclear because it is difficult to understand its meaning. difficult to translate statements are reviewed. Difficulties in translation are related

to the wording and understanding of the original version. Understanding the original version of a statement makes it easier to translate it.

3.2 Validity Results

The translated questionnaire was then empirically tested by administering it to the students. To determine the equivalence of an adapted instrument, researchers can verify this by comparing the results of validity and reliability tests (Hilton et al. 2002). The results of the validity and reliability analyses of the questionnaire data were compared with those of the original version. If no significant differences were found between the original and Indonesian versions, they were considered equivalent. The instrument assessed four aspects: learning environment, student engagement (favorable attitude), well-being, and behavior (scientific inquiry through ICT). Scoring is based on a 5-point Likert scale. The validity test used Pearson's correlation. The test criteria were as follows: if the significance value is <0.5, the questionnaire statement is valid, or if the calculated r value is > r table, the statement is valid. The r table value was 0.2133 for 85 students in this study. Table 1 shows the five statements regarding the learning environment as valid.

Table 1. Validity Results of Learning Environment Aspect

Items	R-calculated	Significance	Remarks
1	0,671	0,000	Valid
2	0,599	0,000	Valid
3	0,707	0,000	Valid
4	0,630	0,000	Valid
5	0,643	0,000	Valid

Table 2 shows the results of the validity test for student engagement (favorable attitude). The validity test results indicate that all three statements in this variable are valid, with each having a significance value of 0.00, which is less than the 0.05 threshold.

Table 2. Validity Results of Student Engagement Aspect (Favourable Attitude)

Items	R-calculated	Significance	Remarks
6	0,841	0,000	Valid
7	0,717	0,000	Valid
8	0,733	0,000	Valid

Table 3 shows the results of the validity test for cognitive variables (career interest). The validity test results indicate that all four statements in this variable are valid, with each having a significance value of 0.00, which is less than the 0.05 threshold value.

Table 3. Validity Results of Cognitive Aspect (Career Interest)

Items	R-calculated	Significance	Remarks
9	0,693	0,000	Valid
10	0,797	0,000	Valid
11	0,687	0,000	Valid
12	0,673	0,000	Valid

Table 4 presents the results of the validity test for well-being. The validity test results indicate that all four statements in the variable are valid, with each having a significance value of 0.00, which is less than the 0.05 threshold.

Table 4. Validity Results of Wellbeing Aspect

Items	R-calculated	Significance	Remarks
13	0,624	0,000	Valid
14	0,799	0,000	Valid
15	0,756	0,000	Valid
16	0,774	0,000	Valid

Table 5 shows the results of the validity test for the behavior variable (scientific inquiry through ICT). The validity test results indicate that all four statements in the variable are valid, with each having a significance value of 0.00, which is less than the 0.05 threshold. From the results of the validity test, it can be concluded that all statements in the questionnaire in each aspect are valid

Table 5. Validity Results of Behaviour Aspect (Scientific Inquiry-Through ICT)

Items	R-calculated	Significance	Remarks
17	0,754	0,000	Valid
18	0,757	0,000	Valid
19	0,780	0,000	Valid
20	0,760	0,000	Valid

3.3 Reliability Results

All statements demonstrated high reliability, as indicated by a Cronbach's alpha value of 0,907. These results suggest that the instrument is reliable, can be trusted to measure what it is intended to measure, and can be used consistently by other researchers to identify learning strategies for classroom use. The reliability test showed that the Cronbach's alpha value for the original version was 0,908, while the translated version yielded a value of 0,907. The results indicate a high level of consistency. The similarity of the alpha values supports the equivalence between the original and translated instruments. Some statements were difficult to translate exactly as they appeared in the original version while maintaining their relevance. The difficulties arise because the translator aimed to ensure that the translated statements conveyed the same meaning as the original statements. See Table 6

Table 6. Reliability Test Result

Reliability	Value
Cronbach's Alpha	0,907
Cronbach's Alpha Based on Standardized Items	0,909
N of Items	20

The table value for a sample of 85 (df = N-2) with a significance level for a two-tailed test of 0.05 is 0.2133. If the calculated r > r table, then the statement is concluded to be reliable. Based on Table 7, it is concluded that all statements in the questionnaire are reliable.

Table 7. Reliability Test Results of the Items

No. of Items	R-calculated	R table	Remarks	Mean	Std. Deviation
1	0,523	0,213	Reliable	3,80	0,884
2	0,424	0,213	Reliable	3,87	0,799
3	0,562	0,213	Reliable	4,12	0,714
4	0,435	0,213	Reliable	4,05	0,634
5	0,575	0,213	Reliable	4,00	0,802

No. of Items	R-calculated	R table	Remarks	Mean	Std. Deviation
6	0,562	0,213	Reliable	3,89	0,859
7	0,525	0,213	Reliable	3,72	0,683
8	0,577	0,213	Reliable	**4,18**	**0,727**
9	0,562	0,213	Reliable	4,05	0,671
10	0,537	0,213	Reliable	3,96	0,851
11	0,574	0,213	Reliable	3,99	0,732
12	0,529	0,213	Reliable	3,95	0,754
13	0,613	0,213	Reliable	3,93	0,669
14	0,543	0,213	Reliable	3,71	0,974
15	0,587	0,213	Reliable	**3,68**	**0,711**
16	0,570	0,213	Reliable	3,81	0,809
17	0,659	0,213	Reliable	3,95	0,722
18	0,465	0,213	Reliable	3,68	0,929
19	0,520	0,213	Reliable	4,01	0,838
20	0,638	0,213	Reliable	3,73	0,822

3.4 Descriptive Results

Table 8. Avarage Mean

	Learning environment	Student engagement	Well-being	Cognitive	Behaviour
Mean	3,99	3,93	3,99	3,78	3,84

All statements indicate a good distribution of data with a standard deviation values range from 0.63 to 0.97. This suggests that the data reflect varied responses from the respondents (students). The distribution of the mean scores for each item (statement) shows a response range (agreement level) between M= 3.68 to M = 4.18. This indicates that students responded positively to the strategy across all measured aspects based on their experiences. The average score for each aspect was calculated to identify patterns in the data distribution (see Table 8). The highest average score was found in the learning environment aspect, with a value of 3,99. It can be concluded that science teachers have designed their instruction using project-based learning and discussion groups.

The adaptation of instruments using appropriate methods is essential to produce a valid and reliable instrument especially related to cross-cultural validation. Considering the importance of the proper adaptation method and the lack of a valid and reliable instrument for measuring students' attitude towards science learning. Translation process is to ensure the instrument equivalence both linguistic and cultural. The use of back-end translation by bilingual experts helped maintain the equivalence of each item's meaning. The validated instrument is a valuable for teachers or researchers who wants measure or assess students' attitudes towards science learning. Cruchinho et al. (2024) stated that cross-cultural validation could affect the research process and results. The translation process requires extensive technical knowledge regarding aspects of translation, adaptation, purposes, and choices. The adaptation process needs to involve the adjustment and validation of the instrument within the cultural context in which the instrument is to be used (Cruchinho et al. 2025).

The translation process in this study revealed that several statements were difficult to translate due to the need to adjust them to the cultural context of the target subjects. However, the results of the instrument's pilot test after translation showed that the instrument's validity and reliability met the criteria or were equivalent to the validity and reliability of the original instrument. The application of back-end translation enabled a re-examination of the translation results to ensure alignment with the original instrument. This method was used to confirm and compare the meaning of the translated items. The translation of items is influenced by the translator's and researcher's awareness in terms of the item's purpose, instruments specification and identification of linguistic ambiguities, as noted by Ozolins et al.

(2020). The process of translation needs to be well-documented, and the translator should be part of the research team. The researcher needs their guidance and suggestions throughout all stages of the research. In addition, the use of various methods for testing validity and reliability can also be applied to assess the consistency of the trial results. Several studies employ different methods of validity and reliability testing. The use of rigorous methods can minimize the occurrence of bias during the process of translation, adaptation, and cross-cultural validation of measurement instruments (Cruchinho et al. 2025).

Many adaptations of the instruments that have been used do not take into account language and cultural differences that significantly affect the findings of the research. The use of adapted instruments has shown that numerous instruments fail to adequately acknowledge or consider the significant language and cultural differences that can impact the outcomes and interpretations of their findings. Researchers should be aware that expert review is crucial in translating and adapting an instrument from another language and that cultural differences will shape the sociocultural context between the original and translated instruments (Puspadewi et al. 2023a). In the research process, this gap is very significant because there are certain crucial factors that play a role in data collection and the interpretation of research results. Sperber (2004) stated that direct translation is the most commonly used method in cross-cultural instrument adaptation. However, this method has a weakness that may affect validity, thereby making the research questionable. Therefore, the appropriate adaptation process will significantly influence the research outcomes in studies that use adapted instruments. By using the proper methods, particularly in the translation and validation of adapted instruments, research bias can be reduced. When researchers overlook the importance of translation and validation processes in research instruments, they risk misrepresenting the experiences of diverse populations. Such results will lead to biased research data and limit the applicability of research findings across languages and cultures. This research attempts explicitly to address these issues to produce an instrument that is compatible with the original instrument and ensures that the data obtained from the measurements using the instrument is more accurate.

The results of this study demonstrate that the process of adapting instruments from different language through back-end translation method was accomplished. Although several words were difficult to translate due to the need for a deeper understanding of the research context, the back-end translation process helped the researchers identify and revise the translation results. For example, the translation of the phrase "science stream for form four and five" from English into Indonesian was difficult. The researcher found the it very challenging. However, the application of the back-end translation method enabled researchers to recheck the translation results, making them more accurate. The validation test results confirmed that all items across the five measured aspects (learning environment, student engagement, cognitive- career interest, well-being, and behaviour-scientific inquiry through ICT) were valid. These results indicate that the items effectively measured the intended constructs within the Indonesian cultural context. In addition, the reliability analysis revealed a Cronbach's alpha value of 0,907, which is nearly similar the original instrument's value of 0,908. It suggests that the internal consistency of the Indonesian version is very strong and comparable to the original. It is very critical in education measurements.

The results of the descriptive analysis describe students' responses to the statements from the translated instrument. The learning environment aspect obtained the highest average score of 3,99. This aspect reflects that students have a positive perception of the science learning environment. Meanwhile, the cognitive aspect related to career interest had the lowest average score of 3.78. This finding indicates that students' interest in pursuing a career in the field of science is not very high. These results can be applied in classroom learning as well as in policy making for school programs aimed at increasing students' interest in science. In addition, another implication of this study is that a rigorous process of translation, adaptation, and validation can produce an instrument that is both linguistically and culturally appropriate for students. This is very important because many cross-cultural studies have not yet applied such methods. This study was able to reduce bias and misinterpretation of the instruments. Nevertheless, further research is needed to confirm the findings, considering the limited sample size in this study. This is necessary to ensure that the adapted instrument can adequately represent an instrument that fits the Indonesian context.

In addition, several difficulties were encountered due to limited knowledge regarding the context of the adapted instrument.

Ethical Approval
Ethical approval was not required for this study

Informed Consent Statement
Not Applicable

Authors' Contributions
EE contributed to the conceptualization, research design, data analysis, and manuscript writing. HDS contributed to the translation process, data collection, and validation testing. RP contributed to the literature review, data interpretation, and proofreading of the final manuscript.

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No potential conflict of interest was reported by the authors.

Data Availability Statement
The data presented in this study are available on request from the corresponding author due to privacy reasons

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