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An Indonesian Translation and Adaptation of the POSTT: A Science Teacher Pedagogical Orientation, Formative Assessment Device

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Abstract: Indonesia has experienced problems in teacher quality, especially science teachers. Teacher-training programs in which preservice teachers are taught to use the most appropriate science teaching methods are critical in order to prepare qualified teachers. Having a formative way to assess and discuss preservice science teachers' preferred teaching orientations is important. Therefore, the Pedagogy of Science Teaching Test (POSTT) was translated and adapted into Bahasa as a formative assessment for preservice science teachers. There were eight steps in the translation and validation of a selected set of POSTT items into Bahasa (Indonesian language) involving Indonesian language experts and science content experts. Pilot study data indicates that the transadapted items are both reliable and valid for use with Indonesian teachers, and that the transadapted POSTT items are understandable and adequately fit with Indonesian school culture. This being the case, science educators in other countries may also wish to employ transadapted POSTT items for preservice science teacher education purposes.
Keywords: *Formative assessment; pedagogical orientations; preservice science teachers; transadaptation*

Introduction

Having a formative assessment for preservice science teachers' teaching orientations is crucial in order to improve teaching quality. Many studies show that few Indonesian preservice teachers, especially preservice biology teachers, incorporate active learning into their science teaching. Most of them prefer teaching science based on textbooks. Therefore, early recognition of preservice science teachers' teaching orientations is important to direct them into using the most appropriate methods for teaching science. This will also will result in the improvement of teacher education programs and also the quality of science teaching (Meirina, 2013). In addition, methods instructors should also be aware of their preservice teachers' teaching orientations and explain the best teaching methods to achieve effective learning (Morine-Dershimer & Kent, 1999). However, because there are no formative assessment instruments, especially for examining preservice science teachers' teaching orientations, available in Bahasa Indonesia, translating and adapting instruments from other languages is essential. One formative assessment that has been developed to evaluate preservice science teachers' teaching orientations is the Pedagogy of Science Teaching Test (POSTT) (see http://www.wmich.edu/science/inquiry-items/).

There are many methods for examining teachers' pedagogical content knowledge (PCK); but according to Baxter and Lederman (1999) there is no best method. A recent study conducted by Authors (2014) resulted in an instrument to assess pedagogical orientations called the Pedagogy of Science Teaching Test (POSTT). The POSTT is a formative assessment

tool that can be applied to examine preservice science teachers' pedagogical orientations specific to the teaching of science concepts. This assessment provides problem-based items to which novice teachers can respond based on their knowledge of teaching approaches. The POSTT uses a multiple-choice format where the possible responses consist of four classroom situations designed to present different teaching approaches: didactic direct, active direct, guided inquiry, and open inquiry (Cobern et al., 2014). Each question has the same four orientations but arranged in different order. When the data is analyzed, the data is transposed so that each orientation has the same letter choice (A is always Direct Didactic, B is always Active Didactic, C is always Guided Inquiry, and D is always Open Inquiry).

Given that such an instrument as the POSTT is needed in many places, it is important to translate and adapt this instrument into several languages in order to be applied in non-English speaking countries, such as Indonesia. Indonesia is a developing country that needs to improve its science teaching quality (Caroline & Wahyuni, 2013). Due to their lack of pedagogical knowledge and exposure to various problem-solving based cases, most Indonesian science teachers prefer direct teaching methods that do not involve active learning. In fact, Indonesia does not have a specific formative assessment for pedagogical orientations. Having this instrument in an Indonesian version will be important and useful for teacher education institutions so that they are able to assess their students' teaching orientation during training.

The purpose of the study in translating and adapting POSTT into Indonesian was to provide a valid and reliable instrument to assess pedagogical orientations for Indonesian preservice science teachers with respect to the teaching of conceptual biology in secondary schools. The focus is biology because the secondary teacher education system in Indonesia is subject specific, such as biology education, in the lead researcher of the study is a biologist. This Indonesian version of POSTT is expected to be widely applicable for Indonesian educational institutions, in will lead to versions specific to other sciences.

Theoretical Framework and Literature Review

Indonesian Teachers' Quality and Pedagogical Orientations

Teacher quality plays an important role in facing global issues, such as international competitions, social and geographical student diversities, and information technologies. Teacher quality it is difficult to define because of the inherent complexity of effective teaching. There is no specific definition of what is a 'good' teacher, except that effective teaching is student-centered (OECD, 2008). Therefore, teacher quality is about pedagogical skills and also about creating learning environments that meet students' needs. Both factors influence students' learning outcomes.

Teachers' qualification is one of the factors that determine teaching quality (Hightower, Delgado, Lloyd, Wittenstein, Sellers, & Swanson, 2011). Sugiarti (2012) says that the quality of teachers in Indonesia is low and should be improved if Indonesia is to have better educated students. Unqualified teachers result in ineffective teaching and learning. Teaching is not merely about transferring knowledge but facilitating students' active learning. However,

teaching for active learning is not happening in most Indonesian science classrooms. Science teachers fail to integrate the nature of science (Anggraeni, *et al.*, 2009). Students end up memorizing science concepts (Muslim, Suhandi, & Karniawati, 2013). Students have few opportunities to express their ideas because the classroom is teacher-centered. Wiyanto et al. (2006) found that secondary science teachers typically use few science activities. Sumintono et al. (2010) found that while some Indonesian science teachers think that laboratory activities are important, their perception of laboratories was different from those promoted in the science education literature. Unfortunately, many Indonesian schools do not support science education with adequate facilities and equipment for student activities. As a result, many teachers are not able to practice science due to facility limitations and so end up using lectures and textbooks. As found by Thair and Treagust (1997), teachers dominate the teaching and learning process and if there is a laboratory activity, students are following the laboratory worksheets instead of being encouraged to think creatively. As a result, students wait for the teacher's command to answer questions. This teaching and learning process relies highly on textbooks.

Teacher Training Institutes (LPTK)

The quality of teacher training institutes determines the quality of teachers. Qualified teachers are important for the provision of good education for students. In these institutions, preservice teachers learn pedagogy as well as content knowledge. Teacher training institutes should, therefore, consider their curriculum and focus on how to prepare preservice teachers to be ready to implement the national curriculum when they teach in schools (Rebell & Hunter, 2004). In Indonesia, the major training for teachers takes place in the colleges of teacher training and education attached to universities and various other public and private education institutions called teacher-training institutes (*Lembaga Pendidik Tenaga Kependidikan – LPTK*).

In the 1990s, facing such teacher quality problems, the Indonesian government implemented an emergency training program to solve the problems of teacher quality and shortages. However, students who were enrolled in emergency teacher education programs had insufficient knowledge, especially in science. Most of them failed to pass the national entry exam for the university science programs or educational faculties of universities (Thair & Treagust, 1997). Teacher education institutions had other problems as well. There was a lack of coordination between teacher training institutions and school systems that led to the poor design of teacher-preparation courses, resulting in unqualified teachers. Schools complained that novice teachers were of low teaching quality. A study conducted by Anggraeni (2009) showed that few Indonesian science teachers used student-centered instructional methods, because during training, preservice teachers were not encouraged to use active learning methods.

The quality of education depends on the quality of LPTKs because these institutions are responsible for producing professional and qualified teachers. In order to fulfill those responsibilities, the LPTKs should consider the training process, such as, the administration, faculty members, curriculum, and facilities. Those factors determine the quality of the alumni (Azhar, 2011). As Rebell and Hunter (2004) mentioned, teacher-training institutions are places where preservice teachers sharpen their

professionalism. To achieve highly qualified teachers, the teacher training institutions should teach the preservice teachers about the learning standards based on the government regulations. It is also important to prepare preservice teachers to be ready to conduct lessons in a range of class situations. Obviously, due to its responsibility in providing qualified educators, the role of LPTKs is important and the quality of LPTKs should be managed properly.

Research on Teaching Orientation Assessment

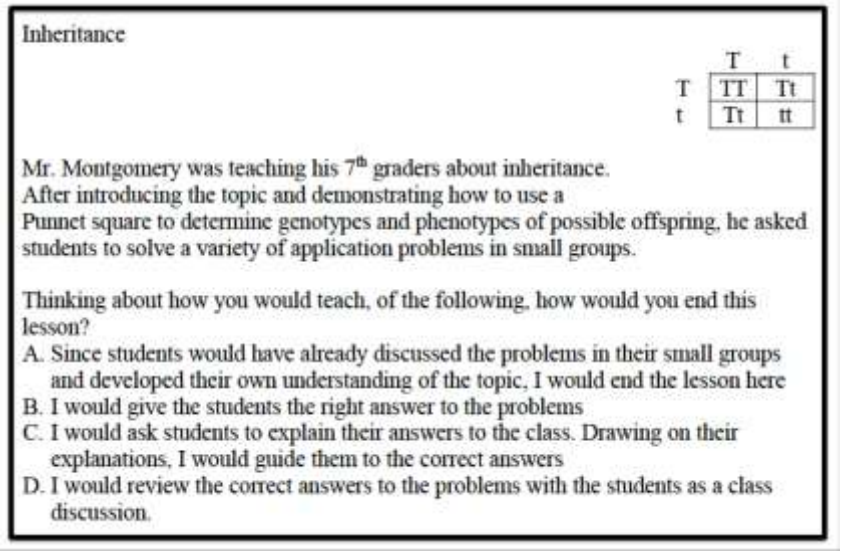
Regarding PCK components, specifically in science teaching, Magnusson, Krajcik, and Borko (1999) argue that one of the components of PCK is teaching orientations. Teaching orientations toward science teaching is about the goals and the nature of instruction. For instance, a didactic orientation is for transmitting the facts of science. The typical nature of this teaching orientation is that teachers present information through lecture or discussion and questioning students to confirm their understanding of science facts (Magnusson *et al.*, 1999). Besides didactic orientation, there are other orientations according to Magnusson *et al.* (1999) including: Process, Academic Rigor, Conceptual Change, Activity-driven, Discovery, Project-based Science, Inquiry, and Guided Inquiry.

If LPTKs are to improve, it will be important to evaluate teachers' PCK. Much research has been conducted in measuring PCK and its components using various methodologies and techniques. These techniques include paper and pencil tests (some are multiple-choice exams), concept maps, pictorial representations, interviews, and multi-method evaluations (Baxter & Lederman, 1999). Among those techniques, each of them has advantages and disadvantages. For example, multiple-choice exams have been criticized due to their poor criterion-related validity, inability to measure many important teaching skills, and being unable to represent minor teaching skills (Baxter & Lederman, 1999). However, researchers have attempted to address such criticisms in their efforts to develop valid and reliable instruments to measure the components of pedagogical content knowledge focusing on teaching orientations that are also easy to use (Cobern et al., 2014). Specific to the teaching of science concepts, Cobern et al. (2014) reports the development of an assessment instrument called the Pedagogy of Science Inquiry Teaching Test primarily for the formative assessment of teacher pedagogical orientations.

POSTT for Pedagogical Orientation Assessment

Assessing preservice teacher performance has become important in order to measure teacher competencies for the purpose of professional development (Wei & Pecheone, 2010). As a result, providing valid and reliable instruments that can show teacher competencies and performances are crucial. Wei and Pecheone (2010) also say that the most common format for assessing teacher candidates at the university level is formative assessment, which generates detailed information of specific strengths and weaknesses of candidate performance compared to summative assessments. Information about candidate performance will be useful to support his or her knowledge development as well as for pre-service teacher program improvement. The most recent research in developing a formative assessment for preservice teachers was conducted by Cobern et al. (2014) and resulted in an instrument called the POSTT.

The POSTT is a problem-based, formative assessment of science teaching orientations, which provides a set of problems with four different teaching orientation options presented as the solutions. An example of an item is shown in Figure 1.


Inheritance

	T	t
T	TT	Tt
t	Tt	tt

Mr. Montgomery was teaching his 7th graders about inheritance. After introducing the topic and demonstrating how to use a Punnet square to determine genotypes and phenotypes of possible offspring, he asked students to solve a variety of application problems in small groups.

Thinking about how you would teach, of the following, how would you end this lesson?

A. Since students would have already discussed the problems in their small groups and developed their own understanding of the topic, I would end the lesson here
B. I would give the students the right answer to the problems
C. I would ask students to explain their answers to the class. Drawing on their explanations, I would guide them to the correct answers
D. I would review the correct answers to the problems with the students as a class discussion.

Figure 1. Example of a problem-based formative assessment

Those options are *Direct Didactic, Active Didactic, Guided Inquiry,* and *Open Inquiry* (Cobern et al., 2014). This instrument provides realistic classroom vignettes and then asks teachers to choose from one of four teaching orientations in order to indicate how they would prefer to teach in that scenario (see Figure 1). Within a set of given problems, the preservice teachers are expected to select the most appropriate answer based on their preference. There are no right and wrong answers because this assessment examines preservice teachers' teaching orientations. Those orientations represent teacher competencies in conducting a lesson in real classroom situations. Applying the POSTT in Indonesian teacher colleges is expected to improve the quality of student learning as well as evaluating school improvement based on test results (CERI, 2008).

As a formative assessment, the POSTT can be implemented broadly as well as improving preservice teachers' metacognitive skills (CERI, 2008). This means that teacher candidates are able to understand their learning and improve their understanding based on what they have learned. Using the POSTT exposes preservice teachers to a range of pedagogies that will indirectly enrich their knowledge of teaching orientations. Considering the difficulties of providing opportunities for preservice teachers to practice all of their pedagogical content knowledge in real classroom situations, the POSTT can be of help. The results can be used to evaluate student performance. If students are selecting the least effective teaching approach to answer the problem-based questions, the instructor, the school, or the educational institution can make revisions in order to improve education quality. Since Indonesia has no formative assessment instruments for use with either preservice teachers or inservice teachers, translating and adapting the POSTT into Bahasa Indonesia for use in LPTKs with Indonesian preservice teachers has the potential for improving science teacher education.

Methodology

This research involved the transadaptation (Montoya *et al.* 2011) of selected POSTT items from English into Bahasa Indonesia (the first language of Indonesia) for formative assessment purposes. The adaptation of this instrument is based on the differentiation of culture between the American and Indonesian education. Without reducing the main ideas of the original version, the Indonesian version of POSTT is expected to be useful for assessing preservice science teachers' teaching orientations, especially preservice biology teachers.

Translation and Adaptation of POSTT for Indonesian Science Teachers Education

Montoya *et al.* (2011) showed that the transadaptation process of instruments is complex because there are many considerations such as how this instrument fits with the culture of the target language and how to find the most appropriate terms in order to minimize lost meaning. A resulting high quality of transadapted instruments is expected, which is determined by expert teams that should do proper translation and review of the questions (Cohen, Gafni, and Hanani, 2007). Basically, the process of transadaptation consists of translation and back-translation techniques, but this is inadequate to obtain an equivalent instrument (HSRI, 2005). As a result, in translating and adapting POSTT for Indonesian Science Teachers, adapted and modified methods from several references were applied (HSRI, 2005; Cohen, *et al*., 2007; and Sousha & Rojjanasrirat, 2010).

In addition, the pre-final Indonesian version of POSTT was pilot tested with Indonesian preservice teachers. Since teacher education for preservice science teachers for secondary school in Indonesia is separated into biology and physics, this study focuses on translating and adapting POSTT for preservice biology teachers of secondary school. The translation and adaptation process of the POSTT items followed eight steps:

The first step was the selection of eight items that were then culturally adapted to Indonesian school culture (pre-translating adaptation). A hundred POSTT items have been developed. These items vary by grade level (K-8) and science content. The primary researcher (who is a native Bahasa Indonesia speaker with English fluency) selected items appropriate for translation into Bahasa Indonesia. The appropriateness of the selected items was based on targeted subjects, who are preservice biology teachers. Thus, the set of 100 was reduced to those grades 6-9 and with content related to biology in Indonesian curriculum. From these, eight items deemed appropriate for Indonesian school culture and curriculum were chosen. These eight items were transadapted by the primary researcher.

For the third step of the process, three Indonesian bilingual reviewers (one was a high school English teacher, a second was a physics high school teacher, and the third was an English translator) independently reviewed the transadapted items. The reviewers were selected based on their fluency in Bahasa Indonesia and English. These bilingual reviewers provided an independent comparison of the transadapted POSTT items with the originals. They reviewed for accuracy of the transadaptation, the clarity of the sentences, the difficulty of the words, and the fluency of the language. In the fourth step, the primary researcher revised the transadaptations based on the reviewers' comments.

After the transadapted POSTT was revised, it needed to be translated back to the original language. In this step, an independent translator who was not involved in the earlier translation translated the Indonesian POSTT back into English. The first language of the translator should be the same as the source instrument language, which was Bahasa Indonesia.

The sixth step was reviewing the back translation by the POSTT research coordinators (co-authors of this paper). The purpose of this stage was to compare the original and back translation of the transadapted POSTT to determine whether or not the original POSTT was translated into Bahasa Indonesia appropriately. Validation process was also done on this step. The validation process of the transadapted instrument was based on a method adapted from Montoya, Llopis, and Gilaberte (2011). The process of validation was included in the translation process, where the committee compared the original and the back-translated POSTT by considering language comparability, similarity of interpretability, and degree of understandability. The language comparability means the formal similarity of words, phrases and sentences. The similarity of interpretability refers to similar interpretation of the two versions even though they are in different words. Lastly, the degree of understandability considers the comprehension of the content although the words are different (Montoya, *et al*., 2011).

During the validation process, five experts compared the back translation of POSTT with its source. This process was slightly modified because none of those experts spoke the target language. The only person who spoke the target language was the researcher. As a result, the process of testing the comparability, interpretability, and degree of understanding was based on the back-translated POSTT. The researcher confirmed and explained her translation to the experts and made revisions when necessary.

The seventh step was pilot testing of the pre-final version of the instrument in the target language. The participants were Bahasa Indonesia speakers and preservice biology teachers. The purpose of testing the pre-final version of Indonesian POSTT was to evaluate the clarity of the instructions, response format, and the items (Sousa & Rojjanasrirat, 2010).

Finally, after completing those previous steps, the final transadapted version of POSTT was ready to be tested for reliability and then implemented. To gauge reliability we used a test-retest method with 17 respondents. Given the N of 17, the resulting Cronbach's Alpha value was a respectable 0.675 (Griethuisjen et al., 2014). Taber (2016) found that some research instruments in science education obtain Cronbach's alpha below an acceptable value (0.6) with five questionnaires item but the researchers argued that the alpha value can be improved by increasing the number of items. The transadapted POSTT would also lead to a higher Cronbach's alpha value by increasing the number of translated and adapted items.

Field Studies

The Indonesian POSTT was subsequently applied in Indonesia as the target country. Participants were selected from a targeted population in which the instrument would be used. In this case, preservice biology teachers at an Indonesian University who were in the sixth semester were selected as a sample. The study had an adequate sample size of 55 preservice biology teachers, as per Sousa and Rojjanasrirat

(2010). The preservice teachers were asked to answer eight Indonesian POSTT items. The data was analyzed for descriptive statistics and histograms for each POSTT item per student using SPSS.

Findings

Data Analysis

Two steps were taken to prepare the data for analysis. First, the data was carefully entered into a Microsoft Office Excel spreadsheet. To insure accuracy, the Excel spreadsheet was cross-checked with the original questionnaire forms and any errors corrected. Once the accuracy of data had been confirmed, the data in the Excel sheet was imported into SPSS 22.0 for Mac.

After the data was completely imported into SPSS, the next step was setting the variables and saving the original copy of the data file. In SPSS, the type of data, values, and measures were set before the data is analyzed. All of the data were numeric including the demographic variables, which were gender and school year. The values for gender are male and female, coded as 1 and 2, while the year has four values; they are first year (1), second year (2), third year (3), and fourth year (4).

The original POSTT data was then copied for recoding. The response choices were randomized on the original questions so that the respondents would not be able to recognize patterns easily. The original data contained the item response codes in the same random order as used for each POSTT item on the survey. These original item codes were recoded as follows: all Direct Didactic answers were recoded as 1, Active Didactic recoded as 2, Guided Inquiry recoded as 3, and Open Inquiry recoded as 4. This new data was then saved as a recoded data file. The original data file was kept as a backup. The recoded data then was ready to analyze using simple descriptive statistics and histograms.

The demographic data shows that most of the respondents are female and are in the third year of study (Table 1).

Table 1.

Demographic data of respondents

Gender	Frequency	Percentage
Male	17	30.9
Female	38	69.1
Total	55	100

Year	Frequency	Percentage
First	1	1.9
Second	7	1.3
Third	46	85.2
Total	55	100

The data indicates that preservice science teachers' responses were varied. Table 2 shows that none of the items received only one response. Five of eight items (62.5%) have all four orientations selected at least once (items 1, 4, 6, 7, and 8). Items 3 and 5 each elicited three responses.

Table 2.

Item Response Variation

No. of different choices	No. of item (%)
1	0 (0.00%)
2	1/8 (12.5%)
3	2/8 (25%)
4	5/8 (62.5%)

The spread of the responses was varied showing that each respondent selected at least three different

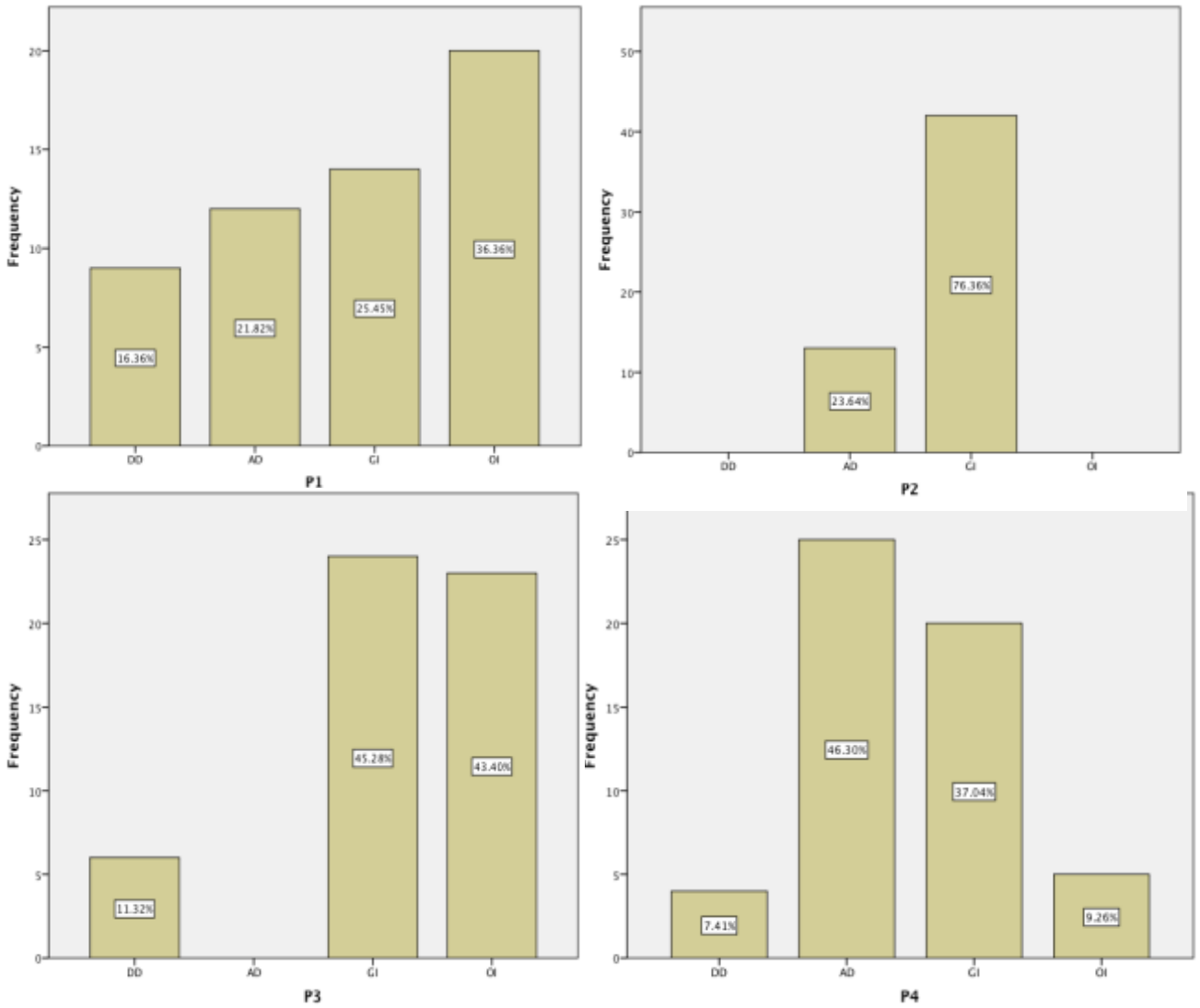
orientations across the eight items, which means that no respondent selected only one or two responses for all eight items. Table 3 shows that more than 50% of respondents (32 preservice teachers) used all four responses to answer the questions while the rest of them used three different options.

Table 3.

Student Responses Variation

No. of different choices	No. of student (%)
1	0 (0.00%)
2	0 (0.00%)
3	23/55 (41.81%)
4	32/55 (58.18%)

The bar charts (Figure 2) show the number of respondents who selected each instructional orientation per item (item profiles). These charts represent the teaching orientations for this Indonesian sample per individual POSTT item.



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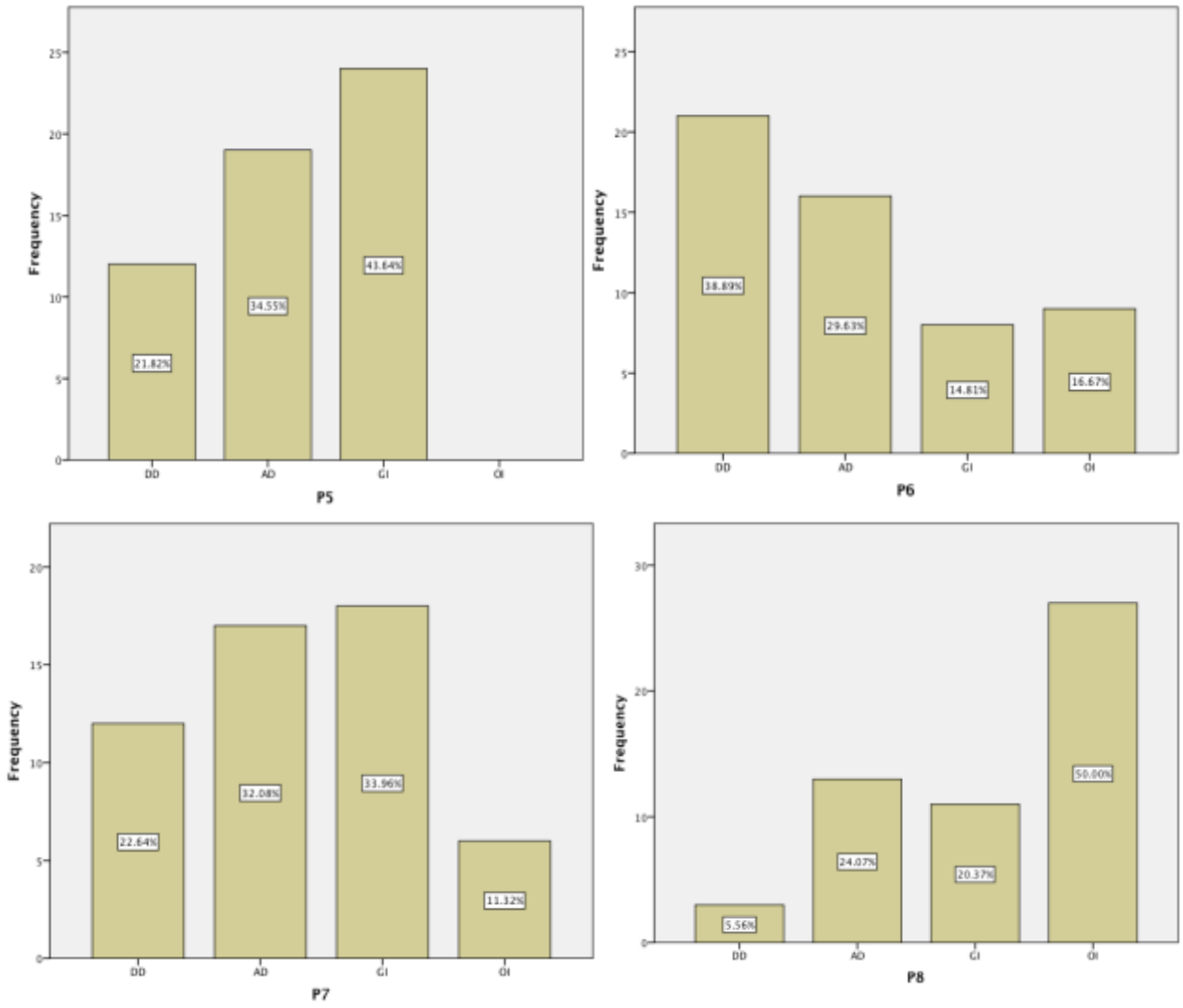

Figure 2. POSTT item profiles

There are six items that elicited a strong inquiry response, either guided inquiry (GI) or open inquiry (OI) (Figure 2). Items number 1, 7, and 8 elicited the choice of all four orientations while the three other items received two or three responses with respect to inquiry orientations being chosen most frequently. This means that for these particular items, one of two inquiry orientations was preferable. Besides inquiry-based instruction response, there are two other items (items 4 and 6) that receive didactic instruction as the highest preference in teaching that science topic (Figure 2).

Discussion

Based on the pilot study, the responses are spread through the items. None of these items elicited only one response type; and only one item (P2) elicited only two kinds of responses (Figure 2). The same result was also found in the pilot study of the original POSTT, in which the item responses are widely spread among the four options (Cobern et al., 2014). It can be assumed

that respondents understood the situations given in the items and already had adequate knowledge to determine what instruction they would prefer to apply to a certain topic (Cobern et al., 2014). Besides the data showing that the transadapted POSTT items drew various responses, the data also shows that each respondent selected various orientations in response to the eight items. Presumably, the respondents were using their knowledge in selecting answers for each item. The spread of responses can indicate that the respondents were not selecting similar approaches for every teaching situation. This knowledge can be related to either pedagogy or content. This being the case, this instrument can be reliably used to assess Indonesian preservice science teachers' teaching orientations.

Noticeably, the POSTT item responses showed that some items earned high responses of inquiry-based teaching approaches while other items had didactic-based teaching methods. Interestingly, based on those items dominated with strong inquiry-based responses, the preservice science teachers exhibited different preferences in using inquiry-based teaching approaches, in which different science topics might be taught using different inquiry-based methods. For example, items 1, 3, 7 and 8 had both Guided Inquiry (GI) and Open Inquiry (OI) responses. However, the respondents preferred Guided Inquiry in response to questions 3 and 7 while Open Inquiry dominated responses in items 1 and 8 (Figure 2). Similarly, didactic-based approaches were also spread depending on the topic (Figure 2). For items 4 and 8, which were highly responded to based on didactic approaches, show that respondents preferred to apply Active Didactic (AD) to answer item 4 while using Direct Didactic (DD) for item 8. These differences in selecting a preferred method means that respondents show different teaching orientations in teaching a certain science topic, which is based on what students understand about various science teaching approaches that they believe can be applied in the classroom (Cobern et al., 2014).

Another interesting finding can be seen from Figure 2 showing that more than half of respondents used all four responses to answer the eight POSTT items. There are some factors that influence the way respondents were using four responses to respond to all POSTT items. Since most respondents are preservice biology teachers who are in the third year of school, they might have learned various teaching approaches that provide them ideas to implement in such a classroom situation as presented in the POSTT items (Cobern et al., 2014). Although the way preservice science teachers selected any item response was not far from their preference in selecting a certain teaching method, their experience in studying science pedagogies and teaching methods will also contribute to the process of selecting a preferred method of teaching. Therefore, preservice teachers who have little knowledge of pedagogy might have less variation of teaching approaches to apply in the classroom.

Conclusions

Considering the quality of education in Indonesia, having a formative assessment for preservice teachers might be one of the solutions to improve teacher quality. Therefore, using the transadapted POSTT, teacher training programs in Indonesia will be able to assess the preservice science teachers' teaching orientations that represent pedagogy and content knowledge. These are important factors for training because preservice teachers learn how to teach

appropriately during their preparation. Preservice science teachers' teaching preferences are indirectly showing their orientations when they teach in schools. Therefore, the use of the POSTT instrument provides sets of classroom environment examples to promote preservice science teachers' teaching orientations.

The Indonesian version of POSTT has been validated and applied into the target language. The pilot study showed that all variables were valid and the transadapted POSTT instrument was understandable and fit into Indonesian culture. There were diverse responses from the participants, in which they were using all given options to answer the questions. Apart from that, each item also received various responses. None of the items had only one response from all respondents. This means that participants' responses distributed widely through the options. It can be concluded that this pilot study shows positive results for translation and adaptation of POSTT into Bahasa Indonesia.

Considering the advantages of having a version of POSTT in Indonesian, it might be possible to translate and adapt more POSTT items since for this preliminary study only eight items were specified for preservice biology teachers. It is also possible to work with more science topics and various grades to make the use of Indonesian version of POSTT widely applicable for all Indonesian science teachers.

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