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The development of Assessment of Science Instruction in English (ASIE) to assess teaching skill in English of prospective science teacher

I U Wusqo*, S D Pamelasari and R D Hardianti

Integrated Science Department, Faculty of Mathematics and Natural Sciences,
Universitas Negeri Semarang, Indonesia

*Corresponding author: urwatin@mail.unnes.ac.id

Abstract. This research is a research that aims to develop an assessment of Science Instruction in English (ASIE) and its implementation to assess valid and effective science teaching skills in English. The research design used was Research and Development. This design uses the ADDIE model. Data collection in this study using the method of observation, questionnaire and documentation. Data from the research results were analysed using quantitative descriptive analysis methods. The feasibility of the instrument is determined based on the feasibility test assessed using a validation sheet. The conclusions obtained were successfully developed in English (ASIE) Assessment of content instruction using ADDIE design, with very valid criteria with a score of 83.95 and practical with score 90.28%, and useful in measuring teaching ability in English as an effort to prepare prospective reputable teacher candidates with 90% of students getting grades B and 95% of user responses in good and very good categories.

1. Introduction

Globalisation is a consideration for higher education in Indonesia to prepare its students with the needed competence for working according to their expertise and competing in the ASEAN Economic Community (AEC). Along with the globalisation, English is a communication medium in the whole world, whether in local or in a global context. The importance of English give people understanding to work with English all the time. This requirement is also applied in Indonesian university, including Universitas Negeri Semarang to elevate its international reputation. That is to say, the Science Education program of the university needs to prepare its students for the global scale of education. Responding to the demand of English, the program made constant and continuous enforcement to improve the pre-service facility for English science teacher to enhance the competence of science teacher in English. Therefore, future teachers will be able to get a reasonable job offers, promotion, or careers.

As stated by Yunus and Sukri [1], nowadays, people with the capability of speaking English tend to get more economic significances. Since mastering English is an important thing to help a country to develop to a higher level by defending its competitiveness and productivity in the global arena. One of the ways for a science teacher to compete is to teach English in Science Instruction unit on 2015 Curriculum based on KKNi (National Standard of Competence) and Conservation.

Science Instruction in English provides microteaching training for students in English. Teaching English, which is integrated with the context of science, can be done through CLIL (Content Language Integrated Learning) [2]. CLIL does imply not only the teaching of content but also the proliferation of



English for students. The fact means that teachers should be able to do that based on the fact that students learn the material through language and knowledge. As a result, it is suggested that the teacher should be able to plan its teaching, which copes the target of the word. In the learning of SIE, the expected content is the content of science, while the mastery of language is also expected. However, in Lee et al [3], the learning of English provides challenges for the teacher. It is the main thing for a science teacher to make students able to be sure with their English, especially since they do not use English in their daily life. Besides, science teacher needs to be able to (1) represent and explain the concepts in their fields clearly and accurately, (2) illustrates confident statement which is similar to other words in English with different phonological way, and (3) represent classroom talks for asking, paraphrasing, clarifying, motivate, and manage the classroom in English.

Therefore, science lecturers need an authentic assessment to assess science teachers' English classroom language skills and their ability to teaching science. Julaha and Sapriati [4] explained that the ability to teach can be measured using professional performance tests in an authentic context. The lecturers should be able to develop and validate authentic tools to assess teachers' ability in planning, teaching, evaluating, and directing the reflective activity in the classroom according to the standard criteria. The performance assessment tool is more valid comparing to traditional test. As in Ahmed et al [5], alternative assessment integrates the measurement of learning outcome with the whole learning process, the evaluation itself is a part of the learning process. With this alternative assessment, it is expected that the measurement of the learning process is not considered as a less interesting and a separated part of a learning process. This thing is also explained in [6] as a tool to unveil the ability of teaching, improving learning skills, providing feedback, and determining the level of competence. Assessment can be done face-to-face, to individuals, through the supervisor's rating, and providing notes. Therefore, this research aims to develop and find the best assessment which is valid, practical, and useful for the Science Instruction in English class to measure science students' teaching skills in English.

2. Methods

This research aims to obtain the assessment model for the Science Instruction in English class to measure science students' English proficiency and ability in teaching. The study employs the research and development approach (R&D). This R&D follows the sequence of ADDIE [7] with the steps of (1) Analyze, (2) Design, (3) Develop, (4) Implement, and (5) Evaluate. This research uses ADDIE since the sequences are precise and efficient for the development of authentic instruments, revision of products in each step, and the appropriation to the characteristics of the product [8]. The subjects of this research are a lecturer who has expertise in educational assessment, an expert of English, and a lecturer in Science Instruction in English class. The data of this research are the validation of the expert of education, English, and the trial from the lecturer. The researchers obtained quantitative and qualitative data. The collected data is used to measure the validity, practicality, and effectiveness of the assessment. The indicators of the success of the evaluation are (1) assessment of science instruction in English (ASIE) is developed, (2) the ASIE is valid with a valid score from the validators, (3) the ASIE is effective determined from a good score in the quantitative data of classroom trials.

3. Results and Discussion

The planning of the content ASIE in English began after the necessity of the science program to establish an international class. Therefore, the department should start on holding Microteaching in English and international teaching internship. The currently used assessment is only limited in Indonesia, while the needs of an international school in foreign countries need the assessment in English. The development of this research follows the sequence of analyzing, designing, developing, implementing, and evaluating.

3.1. *Analysing*

The analysis was done by conducting a prior study. The studies involve field observation and literature review. The observation was done to know the instrument of the assessment, necessary infrastructure, media, reading materials, learning methods in FMIPA UNNES, Semarang. The data were gathered to become a database for documentation and observation. Meanwhile, the literature review includes the theoretical study for the analysis of students' passing grade achievement for the unit and the sub-unit. Also, the researchers review the instrument of assessment in the university for the Science Instruction in English class.

In this step, the developer identifies the gap between the condition of the assessment and the learning outcome. To strengthen the evidence, the researchers conducted a literature review regarding authentic assessment theory in the sense of skills and did an initial analysis to it. From the result, there is a gap between ideal theoretical studies in the fields with the empirical data. Lecturers are proven to have difficulties in assessing the students' ability in teaching science in English while the students are practising the Science Instruction in English class. The first step is the process of the analysis of students' passing grade achievement for the unit and the sub-unit. From the study, the researchers got some points, which are: (1) the students' passing grade achievement in SIE cover the mastery of English and the practical ability of teaching in English. (2) the sub-unit analysis of SIE is on the criterion of the capability of using eight science teaching skills in English, which are Classroom Instruction.

3.2. *Designing*

The researcher developed the instruments for ASIE to measure the ability of science students in teaching science in English. ASIE contains three components of teaching, which are students' worksheet, ASIE, and scoring rubric. According to [9], the elements of performance assessment are students' worksheet, scoring rubrics, and scoring guidance. The sheet contains an assignment for students. The instruments for ASIE includes the aspects of the scoring, which is filled by the lecturers. In designing the assessment, the developers planned the sub-unit achievement analysis, which is regulated under the 2015 curriculum of integrated science, which contains the instruments, guidance, and preparing for authentic assessment in the classroom. In this process, the planning can be seen from the main design of the book, which is called a blueprint. The arrangement of blueprint in the assessment can ease the teacher in the mapping of indicator for evaluation that can help the creation of the assessment [10]. The researcher also formulates the instrument for the suitability of the product for the validation from the experts, including from the education experts and language experts.

3.3. *Developing*

The development of the product was done by improving the features of the assessment. The purpose of this development is following [7], which is to produce and validate planned learning product. The standard procedure to the phase of construction includes (1) providing original product and the guidance of scoring; (2) conducting experts validation and revision; (3) fields trials.

3.3.1. *Initial product development of the assessment*

The initial step of the event is growing the prototype. The blueprint is used to become a referring model for the prototype. From this step, the researcher produced a prototype of the instrument of ASIE according to the blueprint. The guidance for ASIE will be arranged by itself, which eases the lecturers to use it. This instrument is an evaluating tool which contains the indicators for teaching science in English through ASIE. The assessment includes eight aspects of scoring, which are (1) preparation, (2) building background, (3) comprehensible input, (4) consistently use scaffolding techniques throughout the lesson, (5) interaction, (6) practical application, (7) lesson delivery, and (8) language comprehension.

The aspects of the performance follow the guidance of scoring to the students. The scoring was done by deciding which step should be included in the check-list or rating scale. In this case, the

researcher used a rating scale with the reason of allowing the assessors to provide a median for the mastery of particular competence. The use of the median is into the scoring unit, which has more than two categories. From the group, the rubric of the scoring will be made with an analytically-constructed rating scale. The rubric of the analytic level has four criteria, which are highly evident (competent) with the score of 4, apparent (competent) with the score of 3, somewhat visible (fairly competent) with the score of 2, and less competent (not competent) with the score of 1. All of these criteria has an explanatory note in the rubric.

3.3.2. Expert Validation and Revision

The validation includes the construct of validity, content, and the language of the product. Validity is related to the compatibility and the accuracy of a measuring unit [10]. A measuring unit is valid if the group is accurate and working accordingly. The prototype of the ASIE instrument is given to the assessors of education and language expert. The writer then used the device of validation as the propriety tool of the product. The result of expert validity can be seen in Table 1.

Table 1. Expert Validation

No	Scoring Indicator	Score		Mean	Criteria
		Validator 1	Validator 2		
1	Propriety of the Content	90	85	87.5	Very Valid
2	Language	68.75	75	71.875	Valid
3	Construct	90	95	92.5	Very Valid
	Average	82.92	85	83.95	Very Valid

Quality of the instrument, which is validity, is related to the accuracy of a measuring unit [10]. The measured validities are content validity and construct validity. These aspects are related to the ability of the assessment to work according to the objective of the research. The validity is also called as the validity of a curriculum because it contains the concept or variable in the curriculum of construct validity, which refers to the stems in the assessment. The compatibility is related to the relation of the instrument or evaluation with a specific concept arranged in the research question [11].

The result of the expert validity shows that the instrument of the assessment is very valid in terms of its construct and content, which obtained the score of 92.5 and 87.5, respectively. The result indicates that the product is correct that it is proper to assess the students in regards to the competence of teaching science in English.

Based on the construct and content, the assessment is based on the 2015 curriculum, which is based on the Indonesian National Standard of Competence and Conservation. The unit and subunit score achievement, as well as the indicator, are based on the development of the curriculum. In terms of the construct, the instrument is very valid to gather the data of the students' skills. The construct is related to the ability of the students specifically or generally in comprehending lecturing materials. The assessment is correctly collect the information regarding the skills of teaching science in English and the concept of the scored skills. Besides, the language of the instrument is also important. The linguistic aspect will help the lecturer in assessing the students. The score of validation for the language is 71.875, which is valid for an assessment instrument.

Despite the high score, the researchers still did revisions to the product from the recommendations of the experts. The suggestions from them were also important for the field trial. The researchers obtained the data of the score from the expert validation sheet while the data for the revision is included in the validation sheet.

Overall, the instrument was valid with an average score of 83.95. The most apparent revision is in terms of language. The correction is given to the students' worksheet, an instrument for ASIE, and scoring rubrics. There are eight aspects of the scoring, which are preparation, building background, and comprehensible input, consistently use scaffolding technique throughout the lesson, interaction, practical application, lesson delivery, and language comprehension. In this research, there were only

three aspects taken, which are science material, learning process, and language. To ease the practicality of the test, the lecturer also includes guidance of scoring in English, which will be contained by teachers, supervising teachers, or peer-teacher. The revision of the instrument can be seen in Table 2 as follows.

Table 2. List of Revision for Prototype 1

No	Part of ASIE	Before Revision	After Revision
1	Cover	No instrument's title	Instrument's title added
2	Guides	No guideline for the objectives	Instructions added
3		Eight aspects have difficult vocabularies	The elements were reduced to three
4	Scoring Rubric	No Indicator for the closing activity	Indicator for closing activity is added
	Scoring Format	No formula of the performance assessment	The method for the evaluation is added

In this step, the researchers did a clarification from the questionnaires given to the expert of language and education. The explanation is to ensure the post-revision status of the product in terms of instrument assessment, language aspect, and practicality in the evaluation. From the analysis, the assessment of the education assesses the theory of the assessment. Meanwhile, the language expert assesses the readability of the evaluation.

3.3.3. The Planning of Fields Observation

After the revision, the assessment is produced. From the change, the researcher conducted a small-scale trial to measure its effectiveness. Afterwards, the researchers conducted fields observation through experts' formative test. The experiment was led to the 7th-semester students who have done the SIE class. The bigger scale of the trial was done to the 6th-semester student of Integrated Science program in UNNES.

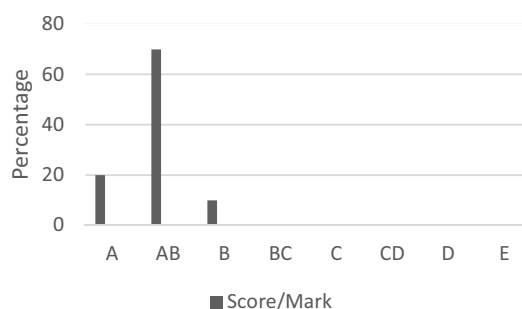


Figure 1. First (small-scaled) trial

3.4. Implementing

The implementation of the research includes the preparation of the lecturers and the students. The preparation also covers the infrastructure for the trial. In this case, ASIE is applied in the designed process of learning. The practicality and effectiveness test of the product is done in the program of integrated science education in Universitas Negeri Semarang. The subjects of the research were the 6th-semester students of the program. The lecturers, students, and the classroom were conditioned based on the planning of the trials. The trial includes the use of authentic assessment on a small scale. The small-scale test was conducted to ten students who have passed the Science Instruction in English

class. From the trials, the researchers revised and upgraded the assessment. The following figure explains the result from the first trial.

From Figure 3, 100% of the students got a score B or higher. From the analysis, the researchers obtained the information from the students that there should be a revision to the indicator of the assessment. Besides, there should be a place for the students to fill their identity, and for the lecturer to fill the date and sign the instrument. The revised part of the device is given in Table 3.

Table 3. Instrument Revision based on First (Small-scaled) trial

Instrument	Revised part
Students' worksheet	The inclusion of indicators to performance assessment
The tool of Assessment of Science Instruction in English (ASIE)	The cover should include the identity of the student, the date of the evaluation and the sign from the assessor

The final evaluation was conducted based on the analysis of the practicality from the user. The revision of the step included the final product, which was an accurate and practical assessment.

Table 4. Practicality Test

	Score	Average	Category
Lecturer 1	91.67		
Lecturer 2	91.67	90.28	Very Practical
Observer	87.5		

Practicality is an essential thing for an assessment. The practicality of the evaluation is the ease for the students to plan, use, interpret, or to keep the data in the assessment [12,10]. The assessment for the practicality was done by validating the evaluation using the judgment from the lecturer of the unit. In this research, the practicality is divided into six indicators [10], which are (1) the clarity of guidelines to use the instrument; (2) the brevity of the use of the tool; (3) the clarity for scoring guidance; (4) firm limit to the score categories; (5) easy access to manage the data/conduct the scoring; and (6) easy access in taking decision based on the assessment.

The effectiveness of the test was measured using two techniques, which are the field observation and scoring from the lecturers. The obtained score for the assessment was 90.28%. The rating showed that the evaluation had a high score for practicality. The fact means that the assessment is easy to understand, to use, to manage, and to report. The instrument is developed in an efficient way which eases the lecturer to gather the data of students' competence to teach science in English.

3.5. Effectiveness

A bigger-scaled trial was conducted to students who take SIE, which are 21 students. From the trial, the researcher revised some parts of the assessment. The instrument of ASIE was implemented to a class after stages of development.

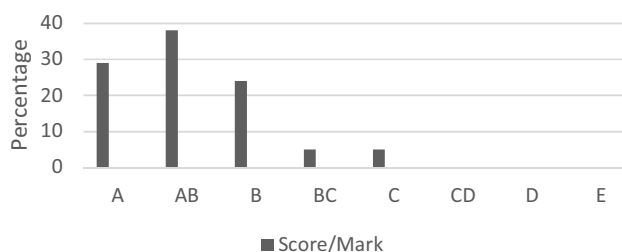


Figure 2. Implementation class

Based on Figure 2, there are 90% of students who got a score higher than B. The lecturers have reviewed the assessment. The result can be seen in Figure 4 that the evaluation was beneficial. The result was supported with the interview to the lecturer, who said that the product is helpful to collect the data of students' skills. The ease was endorsed with the brevity of time and comfortable guideline to follow.

Besides practicality, the effectiveness of the product can be seen in the field trials to know the achievability of the assessment. The efficiency is related to the quantity, quality, and time, whether the instrument has achieved the indicator [12]. The lecturer arranged the index of the effectiveness based on the (1) unit, sub-unit, and indicator of achievement; (2) teaching of science in English; (3) time; (4) the appropriateness of instrument; and (5) the relevance of data and results. The effectiveness of the product was assessed using two techniques, which are the instrument and interview to the lecturer. The finding regarding the product can be seen in Figure 4, that 90% students got a score higher than B. The result is in line previous research [12,13] that an instrument can succeed if it refers to the initial goal the creator set [13]. From each definition, the effectiveness of the assessment can be seen as the collector of the data based on the initial objective of the research. The aim is the instrument which is arranged to collect the information regarding pre-service science teaching skills.

The effectiveness is also obtained from the user's impression. The responses were in the excellent and outstanding category. The reactions were in the level of higher than 95% to the categories. The intense reactions showed that the assessment is valid and useful for the evaluation. As in Purwanti [14], the implementation of authentic assessment system shows that the students feel helped and become more independent during the learning process. Besides, the effectiveness of ASIE is similar to what that the implementation of authentic assessment gives a positive contribution to students' cognitive development in four skills of English, including reading, writing, listening and speaking.

3.6. Evaluating

The evaluation includes each step of ADDIE. There are two steps of assessment, which are formative and summative evaluation. There is also a revision if needed [7]. The evaluation is a formative evaluation in each phase of ADDIE and the correction to know whether a product is valid or not. In each step of evaluation, the development copes the validity, language propriety, and the practicality of the product. The action is the last effectiveness test for ASIE. The responses from students and lecturer were taken and the result was 95% of students agree with the easiness of ASIE.

4. Conclusion

The experts' validation shows that ASIE is proper enough to use based on the content, construct, and language aspect. The facts can be seen from the validators' score to the assessment, which is mostly very valid. The trial in the Science Instruction in English Class of Faculty of Mathematics and Natural Science of UNNES shows that the instrument is practical and useful. Based on the analysis, it can be demonstrated that the device of ASIE is authentic, valid, efficient, effective, and proper for becoming a performance assessment. Lecturers rarely conduct the development of the authentic assessment instrument in higher education. Therefore, it is better for the next research to do the same with using reliability test and dissemination of result for a broader scale of effect.

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