

DESIGN AND EFFECTIVENESS OF MATHEMATICS LEARNING PACKAGES BASED ON BILINGUAL METHOD

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Abstract. The specific targets of this research were to produce; (1) Student book (SB), (2) Student Worksheet (SW), (3) Lesson Plan (LP) and to (4) Know their effectiveness of learning packages themselves. The development design of the packages was the modification and adaptation of Four-D model (Thiagarajan, 1974), which is encompassing four phases namely; Define, Design, Develop, and Disseminate. The criteria, used as the references of Bilingual Method, refers to; (1) Indonesian Qualification Framework (IQF), based on President Regulation No. 20/2012, (2) English as a language, in which the packages were made, (3) The examiners are native speakers, (4) The structure of the learning packages, which can lead students' paradigm, insight, and knowledge to worldwide things. The research finds that: (1) Quantitatively, the learning packages are generally effective to improve students' achievement, specifically shown by the increase of students' grade from the pretest to posttest as many as 8.16 in 100-grading scale and, (2) Qualitatively; (a) the development SB emphasizes on three facets namely; the clarity and the structure of the content, the language, and the problem solving, (b) The development of SW emphasizes on three primary aspects namely; the task direction, the order of the task, and the language (c) The development of LP emphasizes on four primary aspects: formulation of basic competency, time allocation, learning material, and its structure.

Keywords: Design and Effectiveness, Learning Packages, International Standard

INTRODUCTION

International standard education has been organized by Indonesian government in The National Education System Number 20 Year 2003. The regulation states that the central government and/or the local government establish at least one school in each educational level to be developed into an International Standard School (ISS). An ISS is a school that satisfies all standards of national education and is enriched by contents referring to educational standards from at least one country that is a member of Organization for Economic Co-operation and Development (OECD) and/or from other developed countries with certain advantages in the educational field.

One of the obstacles to the Indonesian government in the attainment of international standard education is that there has not been international standard learning packages including their effectiveness. The intended learning packages, which has not been internationally standardized is not only in Mathematics and Natural Science domain, but also for the other lessons both in schools and in colleges.

Rationalizations of international standard education through Bilingual Approach are; (1) sociocultural issues which encompasses (a) symbolic and psychological importance for individual's identify and (b) practical value for intercultural communication, (2) economic which consists of (a) globalism economy and economic development (b) limited number of global/regional lingua francas (esp. English as an international language), and (3) cognitive which comprehends (a) additive bilingualism and (b) superior language learning ability and intercultural sensitivity. (Baker, 2006)

The idea of Baker (2006) about Bilingual Approach is relevant to and even it has similarity to the implementation of international standard education in Indonesia by considering that; (1) the method of the bilingual approach is applied to a study program in which English is not its main discipline, (2) the majority of students who are taught using bilingual approach still has low achievement in English language, and (3) the use of Bilingual Approach in learning is highly likely to create more intensive interaction than that of monolingual approach.

PROBLEM STATEMENTS

1. How to design International standard mathematics learning packages for English for Mathematics course?
2. How far is the effectiveness of international standard mathematics learning packages for English for Mathematics course which have been developed?

LITERATURE REVIEW

Several countries have applied bilingual approach for instance; (a) Australia which combines (German/English; Franch/English; Greck/English; Arabic/English; Hebraw/English; Indigenous Language/English and Japanese/English), (b) Thailand, specifically *Sarasas Extra School*, which combines (English/Thai), and (c) Japan, which combines (Japan/English) in the learning process in Katoh Gakuen (Baker, 2006).

Definition of International Standard Education in Indonesian Version

There are several definitions about International Standard Education in Indonesia. Hasibuan (2008) relates international standard education to *dual degree*. It is stated from the result of an interview (Darma, 2006) that one of the distinctions or the differences between ordinary campus and international standard campus is the facilities each has. Besides that, Made (2008) defines it as a college which either undertakes curriculum in which English is a medium of instruction, has library with the collection of books from foreign countries, or establishes cooperation with foreign educational college. In compliance with Made, Azizy (2008) states that International standard education is an education of which the regulations used satisfy international standards. In addition, it has several criteria in the form of international standard (Furqan, 2008).

Upu (2008a; 2008b; 2008c), suggests some criteria about international standard education that as follows:

3. The facilities and infrastructures encompass; (a) learning facilities and learning packages based on ICT; (b) library based software (more preferable); (c) the availability of proper class room; multimedia; clinic; sport facilities, and (d) contemporary supporting learning facilities.
4. The leaders of the faculties; (a) satisfy minimum master degree graduated from High College which is minimum B accredited in either domestic or graduated from High College in abroad; (b) are capable of speaking English actively; (c) have wide conception and are able to establish international network, possess managerial competency, and have a good entrepreneur leadership; and (d) are capable of applying several principles of Educators, Manager, Advisor, Supervisor, Leader, Innovator, and Motivator.

5. The Educators; (a) capable of facilitating a learning based ICT; (b) capable of upholding a learning with English as a medium of instruction; (c) have master degree or doctoral degree as their education qualification in B accredited college either in home or abroad; and (d) innovative and creative in organizing learning.
6. The management of the education is multi-cultural; establishes conjunction “sister faculties” to international standard faculties of OECD countries or those of developed nation; free of illegal narcotics, smoke, and violence, and occasionally follows international scientific, mathematics, and technological events.
7. The process of learning is oriented on (a) spiritual intelligence; (b) emotional and social intelligence; (c) intellectual intelligence; (d) kinesthetic intelligence; (e) being competitive, active, and creative intellectual; (f) soft skills; and (g) the use of assessment based authenticity.

Several issues of International Standard Education in Indonesia

1. Low ability of oral English
Lecture’s oral English ability, especially pertaining to the subject is low. Moreover, the motivation and the potency of the lecture in following several courses in abroad is also low. Furthermore, in the opinion of many lectures, as well as Mathematics, English is generally considered difficult to learn and to teach.
2. The discrimination and the exclusiveness among students
International standard education is likely to evoke great distinction among students whose parents are able to fund their children and those whose parents are not able (Upu, 2009a). International standard education needs international standard facilities requiring fund, reachable for parents’ students in international standard education, which is higher than regular standard facilities. Since international standard facilities are inherently prepared for students in multicultural and multiethnic environment and those from various countries. As a result, those students in international standard education may feel better than others.
3. Misconception toward Free fund education (fully subsidized education)
A failure to interpret the free fund education (fully subsidized education) concept from some Indonesian people is a challenge in undertaking international standard education. Whether it is realized or not, that the people, in one side, consider that free fund education (fully subsidized education) is a process in acquiring knowledge where all kinds of needs of the education management is free of charge. However, in the other side, to implement high quality education, it needs high cost which is, indeed, funded by students’ parents especially for those who are whealthy. Education is the responsibility of every person, not only for parents, whose children study at school. The responsibility of education management is confided by National Education System Constitution.
4. Obscurity of the standard of international standard education
To maximize the quality of international standard education in Indonesia, the government needs to definite standards, so that they can be used as a Explicit Reference or the Basic Law. When the standard decree of the International Standard Education is not immediately enacted, every education level and education institution may haphazardly acclaim itself as an International Standard Education. The intended standards cover input, process, and output. Moreover, it may include some operational standards, especially of labor, curriculum in Indonesia, fund, and other necessary standards. Recently, the majority of people measure the standard of international standard education by only seeing the used medium of instruction in teaching that is English and other languages supported by Information Communication and Technology (ICT). In fact, several other standards, including curriculum and *partners help* are occasionally neglected.
5. Partners Help

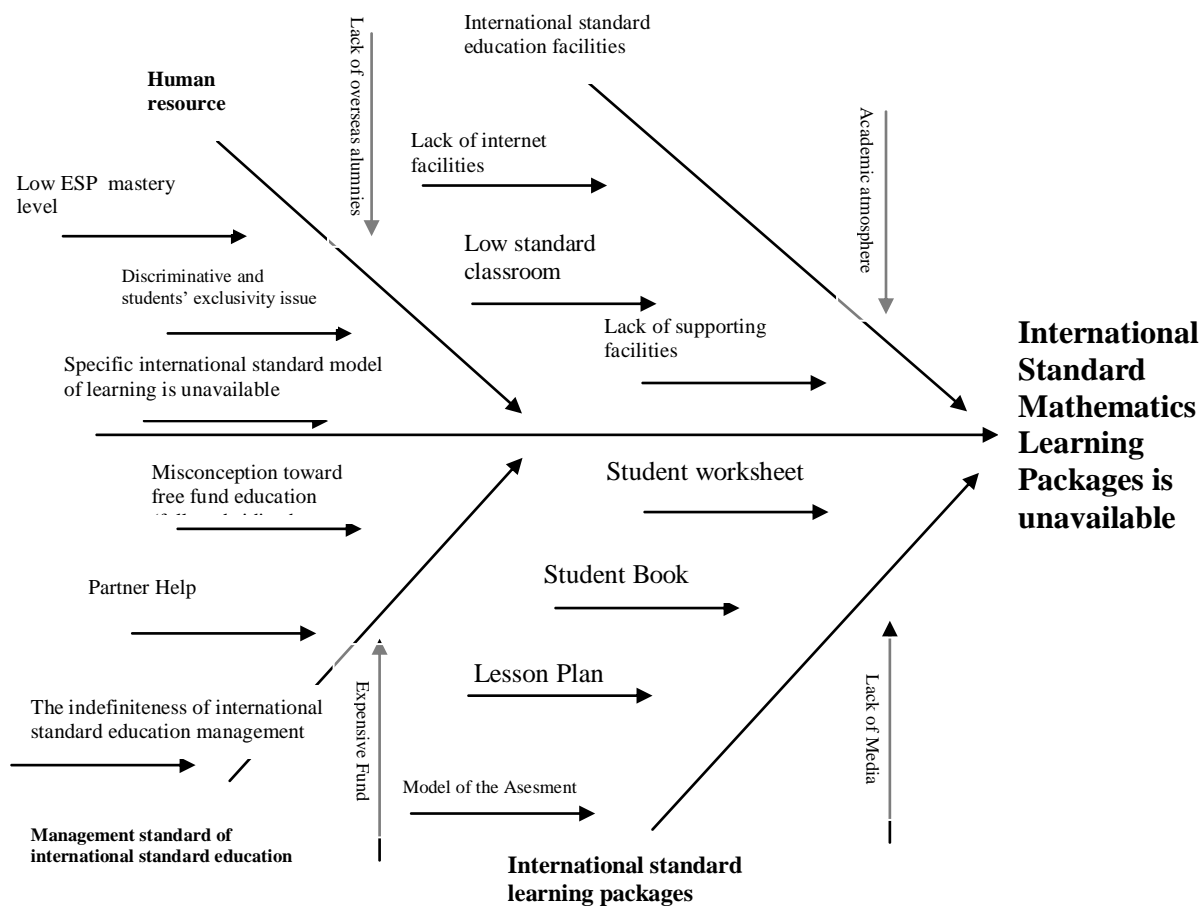
Partnership program between educational college in Indonesia and one of or more educational colleges in developed nation is inevitable. Educational college in developed nation has notable experience in creating the goals of international standard education. One of the critical matters related to this issue is how the developed nation manage their education resource to satisfy the standards of international standard education settled by an authorized board. Consequently, Indonesian government needs to adapt the criteria of education institution from OECD countries or developed nation to be made as a companion.

6. Model of Learning

By considering the ability of each lecture, which is very heterogenous in the term of the English mastery, it needs a reference for model of lecturing. Concerning to this situation. The education college in Indonesia should gain experience from other countries which successfully implement the reference. Subsequent to stipulating a model for one kind of learning, it firms up the approach, the method, and the strategy of learning based on each level of learning.

FRAMEWORK FOR RESEARCH THINKING

The framework for thinking of this research is described in a fishbone diagram



RESEARCH METHOD

This research type was Research and Development aiming at developing Students' book, Students' worksheet, and Lesson Plan. Next, They were studied on how far as their effectiveness in a learning.

Subject and the time of Research

The subject of this research was first semester on "sarjana" program students in International standard Class students, majoring in mathematics education. They have heterogeneous background in the term of mother tongue, language ability, mathematics ability, sociocultural, and parents' education level.

The Instrument and Data Collection

Learning Packages Validation Sheet

The validators are asked to write down the appropriate score by giving a sign (\surd) on an appropriate column. Further, the validators are asked to give general conclusion by using either of the categories: very good, good, fair enough, insufficient, very insufficient.

1. Observation Sheet of Students' activity
The observed students' activities in this sheet include paying attention to lecture's explanation or other students' argument, discussing learning material with other students, solving problems, discussing with the lecture, and doing irrelevant activities, i.e. doing activities unrelated to classroom activities.
2. Observation Sheet of Lecture's ability in managing learning
This kind of instrument is made to obtain data, related to the ability of a lecture in managing as one of data, which support the effectiveness of a learning packages.
3. Observation Sheet of learning packages accomplishment
This kind of instrument is made to obtain data in the field about the learning packages practicality. The process of data collection was done by observers using the observation sheet as a guide for them to observe the accomplishment of certain aspect or the component of the learning packages when lecture hold his or her learning based on given guidelines.
4. Students' Response Questionnaire
The intended data of students' response toward the activity of field test are students' response toward the aspect of learning encompassing the learning topic, Students' book, students' worksheet, the situation in classroom, the lecture's method in learning, the lecture's performance.

THE TECHNIQUE OF DATA ANALYSIS

The results of Learning packages validation

Score in the form of validation from experts and practitioners for each learning package was analyzed by considering advices and comments from the validators. The result of the analysis were used as a guide to revise the learning packages. The process of the analysis consecutively were; (1) recapitulating the assessment from the experts, (2) finding the average of experts' assessment for each criterion, (3) finding the average of each aspect, (4) finding the total of the average (\bar{X}), (5) defining the category of the validity for each criterion (\bar{K}_i) or the average of aspect (\bar{A}_i) or the total of the average (\bar{X}) by consulting to the predetermined categori of validation.

The used criterion to determine the validity degree of the learning packages was the value of (\bar{X}) for the whole aspects which was, at a minimum, included in quite valid category, and the value of (\bar{A}_i) for each aspect included, at a minimum, in valid category. Otherwise, it was necessary to make revision based on the validator's advice and to evaluate several aspects, especially for the low grade aspects. Subsequently, the process of validation was repeated and the data were analyzed afterward. That kind of cyclic process was undertaken until the learning packages was, at a minimum, included in valid category.

The research results indicate that the validity degree of the learning packages; (a) students' book has $\bar{V} = 4,1$ of a category reference as valid is $(3,5 \leq \bar{V} < 4,5)$, (b) students' worksheet has $\bar{V} = 4,1$ of a category reference as valid is $(3,5 \leq \bar{V} < 4,5)$, (c) lesson plan has $\bar{V} = 4,3$ of a category reference as valid is $(3,5 \leq \bar{V} < 4,5)$. Thus, all those packages are *valid*.

Data analysis of students' activities

Analysis of the results of observation toward students activities comprised: (1) the frequency of the average of each activity category for each meeting was conducted by summing up the frequency of the intended activity category divided by the number of observed students, (2) the percentage of each category of students activities for each meeting was conducted by means of dividing the frequency of the average of each category of students' activities (point 1) for each meeting by the maximum sum of the frequency of observations within those meetings multiplied by 100%, and 3) the average of each category of students' activities for all meetings was figured out by dividing the sum of percentages for each of students' activity categories in all meetings by the number of meetings.

The analysis results show that all categories are in a tolerance interval of ideal time that is allocated during the instruction takes place. It is particular for categories of 1, 4, 6, and 7, they must be satisfied. The average value of category 1: to listen to/look at lecturer's explanation actively is 45,33 of a tolerance interval 37 – 47 minutes. The average value of category 4: to carry out problem is 8,67 a tolerance interval 0 - 8 minutes. The average value of category 6: to present/address answers in front of all groups is 10 of a tolerance interval 5 – 15 minutes, and the average value of category 7: to respond their friends' answers or to tell opinion/idea is 12 of a tolerance interval 5 – 15 minutes.

Data analysis of observation to lecturer's activities

The observation was undertaken by trained observer in order to be able to operate the observation sheet appropriately. The analysis result indicates that the totally average of value of lecturer's activities is $\bar{V} = 4,6$ of a category reference as valid is $(4,5 \leq \bar{V} \leq 5)$. Hence, if it is viewed from overall aspects to lecturer's activities, then it is categorized as effective in learning activities.

Data Analysis of Practicability of Learning Packages

The activities administered were as the following: (1) to recapitulate the results of observation to the practicability of learning packages, (2) to find the mode of observation to each activity, (3) to find the mode of each observation aspect for t meetings, and (4) to determine the practicability categories of each aspect of overall aspects by conforming the mode of each aspect of the fixed \bar{A}_i categories;

The analysis results of observations wholly show that the utilized learning packages are "available". The learning packages are also practicable or utilized with good enough and even it can be stated as perfect enough on the basis of the obtained mode value.

Data analysis of students' responses

The activities conducted were: (1) to figure out the number of students that give positive response corresponding to the asked aspect, and then to figure out its percentage, (2) to determine category for students' positive responses by conforming its percentage with fixed criteria, (3) if the analysis results show that the students' responses have not been positive, then it is undertaken revision to the packages being developed.

The analysis results show that all categories are in a tolerance interval of ideal time that is allocated during the instruction takes place. It is particular for category 1, 4, 6, and 7, they must be satisfied. The average value of category 1: to listen to/to look at lecturer's explanation actively is 45,33 of a tolerance interval 37 – 47 minutes. The average value of category 4: to carry out problem is 8,67 of a tolerance interval 0 - 8 minutes. The average value of category 6: to present/to address answers in front of all groups is 10 of a tolerance interval 5 – 15 minutes, and the average value of category 7: to respond their friends' answers or to tell opinion/idea is 12 of a tolerance interval 5 – 15 minutes.

The criteria used as international standard learning packages: (1) Indonesia Qualification Framework of Indonesia, President Regulation No. 20 Tahun 2012), (2) learning packages is written in English, (3) the validators of learning packages are Native Speakers, (4) the structure of the learning packages content can lead students' mind, insight, and knowledge to worldwide things.

The Research Implementation System

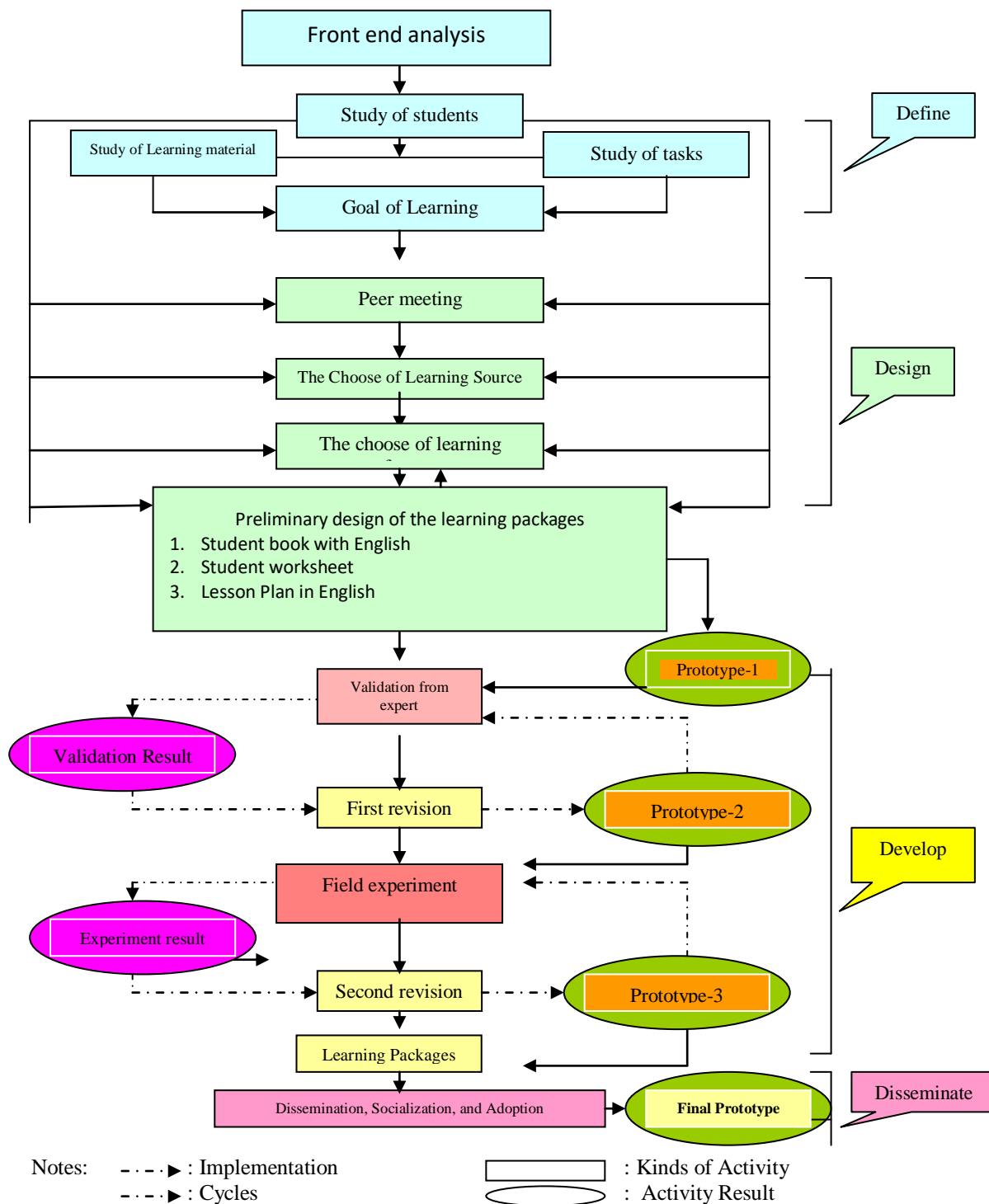


FIGURE 1. The Modification and adaptation of Learning Packages Development Model Four-D Thiagarajan

THE PROCEDURE, PRODUCT, AND TRY-OUT OF LEARNING PACKAGES

The procedure of a learning packages development in this research serially takes following phases:

Define Phase

Define phase aims at determining and defining the necessary conditions in a learning. The activities in this phase are front end analysis, students analysis, learning material analysis, task analysis, and the specification of learning goals.

Front End analysis

Based on review to *English for Mathematics* course in the department of mathematics, state university of Makassar, the fundamental problem in fact that is needed to attempt the solution is the way of presenting lecturing (Upu, 2012). The lecturing currently tends to be lack of providing enough opportunity to students to develop their ideas. As a result, students become passive, lazy to ask question, moreover to express their ideas. In addition, the lecturing process is dominated by lecturer, meanwhile students only already listen to and copy what the lecturer tells.

The analysis and the study of students

Students' prior knowledge is heavily influenced by thinking way that they brought from secondary school. Meanwhile, the used language by those following *English for Mathematics* course tends to have not been formal and their ability to analyze mathematical sentence is still low. Both of them influence their ability to understand mathematics. Whereas concerning students' cognitive development, this domain inclines to be heterogen in terms of English ability. Meanwhile, their inclination to make group and discuss each others to develop their social-culture (Upu, 2009b, 2010a, 2010b) is more homogen.

The analysis and the study of learning material

The material or content analysis is intended to identify, elaborate, and organize systematically the main material that students will learn. The material is organized hierarchically and chosen in the light of basic competence and indicators. Analysis of learning or lecturing material that is provided currently, is less able to build students' insight, mind set, and commitment globally.

The analysis and the study of learning tasks

The tasks that lecture gives to students do not vary. They depend on lecture's desire. In general, quiz in the classroom is given more frequently than homework is. In terms of understanding to learning material, quiz in the classroom is more able to build ability to understand students' material than homework is. Hence, a great deal of learning goals refer to quiz.

The analysis and the study of learning's goals

Learning goals have not described an appropriate hierarchy, either it is according to language or viewed from the mathematical content or material. Therefore, the learning packages, particularly student book and student worksheet must be organized, such that those both situations can be overcome.

Design Phase

The kinds of activities of this phase are the choice of media of the learning, learning format, the design of learning packages, and the choice of learning outcome test. The choice of Learning Source. This kind of choice aims at determining the appropriate learning source to provide international standard learning material. The learning source is also adapted based on the analysis of the basic competency, tasks, and the campus' facilities.

The choice of selingkung model

The choice of selingkung model is based on the importance of understanding to support students' international insight in terms of; learning material, learning model, approach, method, and strategy as well as learning source that will be used and developed.

The product of the development of learning packages and the experiment

The initial design of learning packages for English for Mathematics is done to produce Prototype-I consisting of Student Book, Student Worksheet, and Lesson Plan. The prototype I is developed to produce Prototype-2.

Development Phase

The phase of development aims at producing prototype-2 of learning packages which is in the form of the revision of prototype-1. The advice from experts and practitioners and also the learning activity analysis plays important role in this phase.

Expert and practitioner validation of learning

Expert and practitioner validation is aims at evaluating the content and the language of the learning packages. Its assessment covers several indicators: a) selingkung model, b) language, c) illustration, and d) learning content. Each following indicator consists of several sub-indicators namely

1. Selingkung model, which consists of: the explicitness of learning material arrangement, the numbering of topics, the attractiveness of topics, the balance between the text and the illustration, the kind and the size of the font, the space arrangement, the appropriateness between the physical size and the students,
2. Language which encompasses the veracity of the grammar, the suitability between the sentence and the students' cognitive development and literacy ability, guideline to refer to other reading sources, the veracity of each terminology definition, the simplicity of the sentence, and the clarity of the guidelines.
3. Illustration which comprehends supporting illustration aiming at specifically describing concept and the connectivity between the illustration and the concept, the clarity, the understanding, the use of local context, and the gender deviation
4. Content which includes the correctness of the content, the composition of the content, the suitability of the content to the curriculum, the inclusion of some important related information, the connection between the content and the previous learning material, the appropriateness of the content to the students' mindset, the inclusion of exercises related to the concept, and the stereotype which is not partially focused on several issues (ethnic, gender, religion, and social strata)

The recommendation from experts and practitioners and also the analysis output of prototype-I are used to obtain prototype-2. Its validation includes: (1) the content of the learning packages questioning

is the content of the learning packages suitable to the learning material and the measured learning goals, (2) language: (a) the sentences of the learning packages use well and correct sentence, (b) the sentences of the learning packages are not ambiguous.

After the prototype-1 is assessed and revised based on the suggestions from the experts and the practitioners and also based on a reflective thinking, the prototype can be resulted.

Restricted field experiment of learning packages development

Restricted field is obtained to get direct description from the students and the observers about their responds, reactions, and comments as revision process of prototype-2 aiming at preparing prototype-3. The activities undertaken in the restricted field experiment are: (1) experimenting the prototype-2, that is a suitable instrument satisfying validity criteria. The kind of experiment is the implementation of learning in classroom using valid learning packages and instrument, (2) analysing the result of the field experiment, and (3) revising the learning packages and the instrument based on the result of the experiment to produce Prototype-3.

The main aim of the learning packages implementation in this phase is to know the explicitness, the perusal, and the appropriateness between the planned time/duration in the lesson plan and time/duration in its implementation. The output of the experiment is used for the completion of the learning packages (Prototype). In this phase, research team observes the students' activity, the ability of the lecture in managing the learning, and the accomplishment of the learning packages. The development phase (develop) produces prototype-3, and that prototype is then disseminated to produce the final prototype.

Dissemination Phase

Dissemination phase is performed by undertaking socialization of the finalized learning packages. The socialization can be done through seminar, workshop, and general course which may involve lectures, students, teachers, and educators.

CONCLUSION AND SUGGESTION

Conclusion:

1. The development of international standard learning packages of English for Mathematics course accentuates: a) Students Book encompassing three main aspects namely the aspect veracity of the standard of the competency, the structure, the content, the used language, and the problem solving, b) Student Worksheet including three primary facets namely the direction how to work with the Student Worksheet, the order which should be followed to work with it, and also the language it uses, and c) Lesson Plan which emphasizes four main facets namely the basic competency, time allocation, the learning material, and the structure of the learning content for each meeting.
2. Generally, international standard learning packages is effective to improve students' achievement for students attending English for Mathematics course, specifically shown by the increase of students' score from pretest to posttest as 8.16 of an ideal score 100.

Suggestions:

1. It is suggested for lectures, especially for lectures majoring in Mathematics Education, to mind several important issues in developing international standard learning packages, therefore the learning packages can be made as a rudimentary reference to teach their own subjects.
2. It is recommended for students majoring in Mathematics Education which attends English for Mathematics course to simultaneously integrate the use of learning packages.

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