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THE DEVELOPMENT OF CHEMISTRY WORKSHEET BILINGUAL WITH LEARNING CYCLE 7-E ORIENTATION IN THE REACTION RATE TOPIC AS SUPPORTING LEARNING FOR PIONEERING NTERNATIONAL SENIOR HIGH SCHOOL

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Abstrak : Penelitian ini bertujuan untuk mengetahui kelayakan *Chemistry Worksheet* bilingual berorientasi *Learning Cycle 7-E* pada materi pokok Laju Reaksi untuk SMA RSBI ditinjau dari kriteria isi, kesesuaian dengan model *Learning Cycle 7-E*, kriteria penyajian, kriteria kebahasaan, dan kriteria kegrafikaan. Penelitian ini adalah penelitian pengembangan yang menggunakan desain penelitian *Research and Development (R & D)* dan desain instruksional *4-D models* yang dikemukakan oleh Thiagarajan, namun hanya dibatasi sampai tahap *develop*. Penilaian *chemistry worksheet* bilingual dilakukan oleh 1 dosen kimia, 2 guru kimia, 1 ahli bahasa Inggris, dan 1 ahli media. Pengumpulan data yaitu dengan metode angket. Metode analisis data dilakukan secara deskriptif kuantitatif menggunakan persentase untuk mengetahui kelayakan *chemistry worksheet* bilingual yang dikembangkan. *Chemistry worksheet* bilingual dikatakan layak jika persentase dari masing-masing kriteria kelayakan mencapai ≥ 51% . Hasil penelitian menunjukkan bahwa *chemistry worksheet* bilingual berorientasi *Learning Cycle 7-E* layak digunakan dalam proses pembelajaran karena telah memenuhi kriteria kelayakan isi berturut-turut dari *worksheet* 1, 2, 3, dan 4 sebesar 88,89%; 93,06%; 86,11%; dan 84,72%, kesesuaian dengan model *Learning Cycle 7-E* sebesar 89,39%; 89,39%; 86,36%; dan 87,88%, kriteria penyajian sebesar 84,26; 86,11%; 83,33%; dan 84,26%, kriteria kebahasaan sebesar 75%; 95%; 85; dan 85%, serta kriteria kegrafikaan sebesar 89,29%; 89,29%; 85,71%; dan 85,71%.

Kata kunci : Penelitian pengembangan**,** *Chemistry worksheet* bilingual, *Learning Cycle 7-E*, kelayakan

Abstract : *This aims of this research are to know the feasibility of chemistry worksheet bilingual with Learning Cycle 7-E orientation in the reaction rate topic for beginner international senior high school based on criteria of content, suitability with Learning Cycle 7-E model, presentation, language, and graphisity. This research is development research using Research and Development (R & D) as research design and 4-D models as instructional design that suggested by Thiagarajan, but only limited until develop phase. Assessment of chemistry worksheet bilingual conducted by 1 chemistry lecturer, 2 chemistry teachers, 1 english language expert, and 1 media expert. Method of data collection is questionnaire method. Method of data analysis was done by quantitative descriptive use percentage to know the feasibility of chemistry worksheet bilingual that developed. Chemistry worksheet bilingual is feasible if the percentage of each feasibility criteria reach ≥ 51%. The result showed that chemistry worksheet bilingual with Learning Cycle 7-E orientation is feasible used in the learning process because it has met the feasibility criteria of content respectively from worksheet 1, 2, 3, and 4 is 88,89%; 93,06%; 86,11%; and 84,72%, suitability with Learning Cycle 7-E model is 89,39%; 89,39%; 86,36%; and 87,88%, presentation criteria is 84,26; 86,11%; 83,33%; and 84,26%, language criteria is 75%; 95%; 85; and 85%, and graphisity criteria is 89,29%; 89,29%; 85,71%; and 85,71%.*

Key words : *Development research, Chemistry worksheet bilingual, Learning Cycle 7-E, feasibility*

INTRODUCTION

The society requirement that increasingly to the quality of education indicates that education has become one of the institution that strong, authority, and have the very important and strategic role in the development of nation civilization [1]. Education is one of pillar of the nation success in an effort to increase the living standards of its populace. Education plays an important role in the process of increasing the capability and competitiveness of a nation in the world. If a nation has been able to uphold its education quality, so the nation can become a developed nation. Based on the implementation of globalization era, our country need qualified and can compete human resources which is not only clever in theory but also in skill and creativity. Presence of that human resources are expected to face many changes and challenges of globalization that occur. Therefore, effort to increase the quality of education is very needed because education is the main medium to increase the quality of human resources.

In education sector, the government repeatedly change the educational curriculum starting from curriculum 1994 into *Cara Belajar Siswa Aktif* curriculum. This curriculum then changed into KTSP curriculum in 2004. In 2006, it changed again become KTSP curriculum. This curriculum changes are done by government to find the best educational system so it can increase the quality of education in Indonesia, also the methods that applied.

One of the government's effort in developing national education system as mandated in UU No. 20 in year 2003 about national education system section 50 paragraph (3) which states "Government and/or local government conduct at least one unit of education at all levels of education, to developed into educational unit that have international standard" is the present of beginner international school (RSBI). Depdiknas [1] states that international school is school that have fulfilled all National Education Standards and enriched by reference to the educational standard of one of country which become member of Organization for Economic Co-operation and Development and/or other developed countries that have superiority in educational sector so it has competitiveness in the international forum. Curriculum that used in RSBI is adoptive and adaptive curriculum, the national curriculum that is integrated with an international curriculum.

SMA Negeri 1 Manyar is one of beginner international senior high school since 2007 and the learning process using bilingual. The curriculum that used in this school is KTSP and Cambridge curriculum.

Based on the pre-study questionnaire about the chemistry learning problems in SMA negeri 1 Manyar, 94% of students said that chemistry is an interesting subject to be learned, but 72% of students still have difficulties in learning chemistry because it is combination of subject which include memorized system, understanding the concepts and calculations. One of teaching materials that used is chemistry worksheet that still in Indonesian language and not oriented to the learning model. Depdiknas [2] stated that media in English language is one of component that must be fulfilled in RSBI, so the presence of teaching materials in English is expected for the achievement of learning objectives in RSBI.

Based on the results of questionnaire, 44% of students choose reaction rate as topic that require more understanding because there are many concepts that must be memorized. As factors that affecting the reaction rate topic, this topic should be followed by experiment and related with daily life so the students more interested and easy to understand the topic that learned.

Standard Competence of this topic is understanding reaction kinetics, chemical equilibrium and factors that affecting it, and its application in daily life and industry. Basic competence of this topic are describing the definition of the reaction rate by doing experiment about factors that affecting the reaction rate and understanding the collisions theory to explain the rate determinant factors and the reaction order and its application in daily life [3].

One of effort to minimize these difficulties and increase student' understanding of the concept is optimize the use of material teaching, including the use of worksheet. This is supported by the questionnaire result which states that 91% of students want to worksheet to practice the chemistry problems so that students easier to understanding chemistry topic.84% of students want the presence of bilingual worksheet, not full English in order to easier to understand the concept, the interest worksheet, namely colored, there are images that can clarify the topic, contain summary of topic, chemistry problems, application of concept that relate the topic with daily life, several experiment, can relate the topic that learned with the other concepts, and using easily understood language.

Learning Cycle is one of learning model that based on the constructivist paradigm. This learning model suggests that the learning process can involve students in active learning so that there are process of assimilation, accommodation, and organization in the cognitive structure of students. If construction process of knowledge is occur with good so learner will be able to increase their understanding to the topic that learned [4].

Eisenkraft [5] described the development of Learning Cycle model, it continues to expand starting from 3-E, 5-E to 7-E. Learning Cycle 5-E consist of 5 phase namely engage, explore, explain, elaborate, and evaluate. While Learning Cycle 7-E is expanding of the 5-E model. Learning Cycle 7-E expanding engage phase into two phases namely elicit and engage, and expanding elaborate and evaluate phase into three phases namely elaborate, evaluate, and extend. These changes are not suggested to add complexity, but rather to ensure instructors do not omit crucial elements in the learning process. Learning Cycle 7-E is suitable for the topic that have characteristic are memorized, calculation, experiment, understanding the concepts, and the topic that relate the daily life. Therefore, Learning Cycle 7-E is suitable as model in the compiling the worksheet to increase the student' understanding of concept.

The phases of Learning Cycle 7-E are elicit, engage, explore, explain, elaborate, evaluate, and extend [5]. The elements of Piaget's theory which are assimilation, accommodation, and organization has a correspondence with the phases of Learning Cycle 7-E [4].

Kusumaningsih [6] explain the phases of this model. In *elicit* and *engage* phases, students are given an apperception and motivation which can relate topic that will learned with topic that has been learned previously and give them spirit to learn actively. In *explore* phase, student are given the opportunity to utilize the five senses as possible to interact with the environment through activities such as experiment, analyzing the article, discussing and observing the natural phenomenon, etc. from this activities, students are encouraged to do assimilation causing an imbalance in their mental structure (cognitive disequilibrium) and the emerging questions that lead to the development of high level reasoning. The emergence of these questions as well as an indicator student readiness to pursue the next phase. In *explain* phase is expected emerge imbalance process between the new concepts learned through activities that require reasoning power. This phase correspond with accommodation phase in student' mental function. In this phase, students are

know the terms that relate to the new concepts being learned. In *elaborate* phase, students are invited to apply their concept understanding through activities such as completing the real problems that related with topic or doing experiments. Application of concept can increase of the concept understanding and motivation to learn because students know the real application of the concept that learned. This phase is suitable with organization phase in Piaget theory. In *evaluate* phase, students are given several questions to know their understanding of topic being learned. The last phase is *extend*. This phase can stimulate tha students to find the relationship of concept that learned with the other concept.

Activity using Learning Cycle 7-E model is more determined by students, so students are expected to be more active and more involved in the learning process. In addition, each phase of Learning Cycle 7-E can be passed if the previous concepts has been understandable. Each new and previous phases are related so that make students easier understand concepts [6].

Based on the explaining above, the researcher develop a worksheet that presented in bilingual (English and Indonesia) as language in *explain* phase because it is more efficient to facilitate the student' understanding, but the researcher use English as language in the other phases. It will training and familiarize students to sharpen its English skills. This worksheet use KTSP and Cambridge curriculum. Chemistry worksheet bilingual with Learning Cycle 7-E that developed adjusted the feasibility criteria which include criteria of content, suitability of Learning Cycle 7-E model, presentation, language, and graphisity so it can be supporting in the learning process in beginner international senior high school.

RESEARCH METHOD

This research is the development research, namely the development of chemistry worksheet bilingual with Learning Cycle 7-E orientation in the reaction rate topic for beginner international senior high school. This research use Research and Development (R & D) as research design which consists of three stages, namely introduction, development, and evaluation stages. But in this research is only limited to the introduction and development stages. For development stage using 4-D models as instructional design that suggested by Thiagarajan which consist of four stages are *define*, *design*, *develop*, and *disseminate*. But in this research is only limited until *develop* stage.

Research design of development chemistry worksheet bilingual presented in Figure 1.

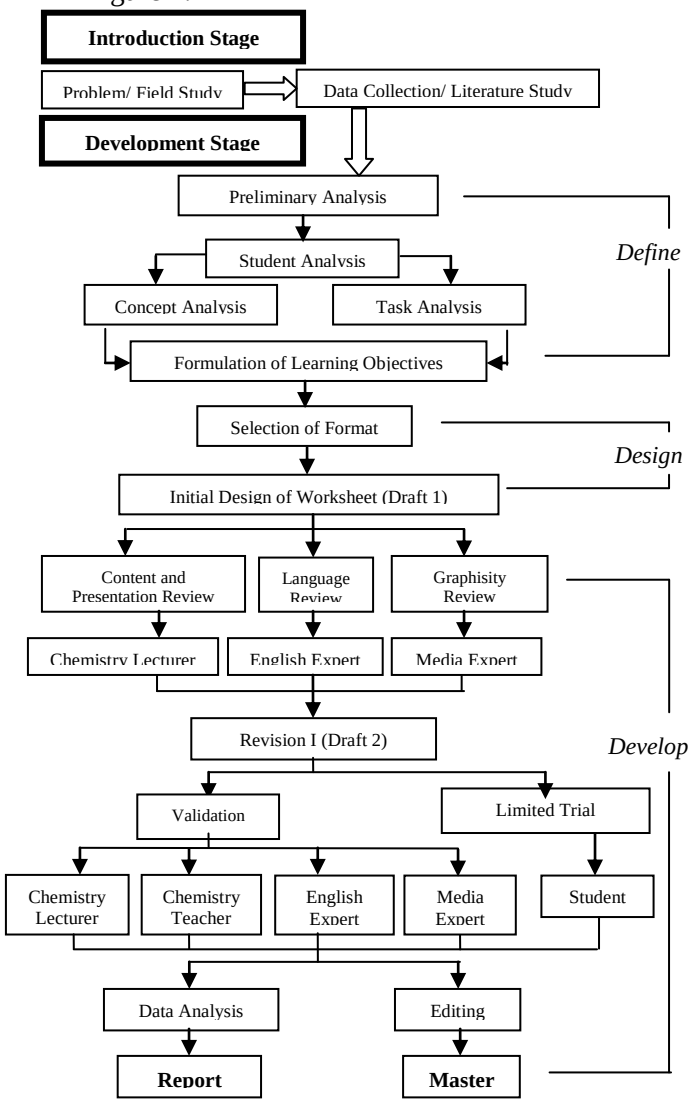

Figure 1 Research design development chemistry worksheet bilingual with Learning Cycle 7-E orientation (Adaptation from Sugiyono [7] and Ibrahim [8])

Chemistry worksheet bilingual is validated by 1 chemistry lecturer, 2 chemistry teachers, 1 English language expert, and 1 media expert. Data of validation result is analyzed by quantitative descriptive method. This analysis conducted on every aspect in validation sheet. Percentage of this questionnaire is obtained by the calculation of Likert scale as in Table 1.

Table 1 Likert Scale

Assessment	Scale value
Very less	1
Less	2
Good	3
Very good	4

(Modification of Riduwan [9])

The formula that used in calculation to obtain the percentage is:

$$P\,(\%) = \frac{Total\ score\ of\ data\ collection\ result}{Criteria\ score}\ x\,100\%$$

Criteria score = the highest score x amount of aspect x amount of respondent.

The percentage that obtained are interpreted in category in Table 2.

Table 2 Interpretation of score

Percentage (%)	Category
0-25	Very less
26-50	Less
51-75	Feasible
76-100	Very feasible

(Modification of Riduwan [9])

Based on these criteria, chemistry worksheet bilingual with Learning Cycle 7-E orientation that developed is feasible if the percentage of each feasibility criteria reach ≥ 51% [9].

RESULT AND DISCUSSION

Data of validation chemistry worksheet bilingual is analyzed descriptive quantitatively. Validation results can be seen in Table 3.

Table 3 Validation result of chemistry worksheet bilingual with Learning Cycle 7-E orientation

No	Criteria	Percentage of assessment (%)				Category
		Worksheet 1	Worksheet 2	Worksheet 3	Worksheet 4	
1.	Content	88,89	93,06	86,11	84,72	Very feasible
2.	Suitability with Learning Cycle 7-E model	89,39	89,39	86,36	86,36	Very feasible
3.	Presentation	84,26	86,11	83,33	84,26	Very feasible
4.	Language	75	95	85	85	Very feasible
5.	Graphisity	89,29	89,29	85,71	85,71	Very feasible

Based on Table 3, chemistry worksheet bilingual that developed can be said to have met the feasibility criteria of content according to BSNP [10] because having an assessment of ≥ 51% [9]. The percentage of content feasibility respectively for each chemistry worksheet is 88,89%; 93,06%; 86,11%; and 84,72%.

The validation result of content criteria is obtained because the topic in chemistry worksheet bilingual suitable with KTSP and Cambridge curriculum, suitable with Standard Competence (SK) and Basic Competence (KD) that will be achieved, relevant with indicators and assemble the important concepts. This indicate that chemistry worksheet bilingual contain topic with the accuracy of fact and concept. It means concept that presented according with the fact, does not make many interpretations, and suitable with definition that applicable [11]. The question of evaluation in this chemistry worksheet is easy to understand and suitable with indicators and Basic Competence (KD).

The validation result of suitable with Learning Cycle 7-E model respectively for each chemistry worksheet is 89,39%;89,39%; 86,36%; and 86,36%. This is indicate that chemistry worksheet bilingual that developed has been met the criteria of suitability with Learning Cycle 7-E model for all aspects that studied so that having an assessment of ≥ 51% [9].

Aspects of suitable with Learning Cycle 7-E criteria include : eliciting students' prior understanding (*elicit* phase), chemistry worksheet bilingual is suitable with elicit phase because it contain the fundamental questions related to the topic that has been learned previously with take an example such as phenomenon in daily life. Aspect of *engage* phase are stimulate students' thinking skills and awaken students' interest and motivation. Chemistry worksheet bilingual contain questions with picture and explanation that related to the daily life that can stimulate the students to think more deeply, able to awaken students' interest and motivation so that they more enthusiastic to follow the topic that learned. Aspect of *explore* phase is give student opportunity to explore its knowledge by work individually. Chemistry worksheet bilingual contain the discourse to be analyzed individually without instruction from teacher so that can give student opportunity to explore its knowledge. Aspect of *explain* phase are show pictures and descriptions that related with the concept to complete explanation of students in the *explore* phase and encouraged students to explain the concept by doing the problems in *explain* phase by discussion. Aspect of *elaborate* phase are encouraged students to apply the concepts that have been owned by planning experiments, record and analyze experimental results in group and give students opportunity to present the experiment results. Aspect of *evaluate* phase is give the problems as evaluation of the activities that have been done start from *elicit* phase until *elaborate* phase. Aspect of *extend* phase is stimulate students to find the relationship of concept that learned with the other concepts that have been or not learned.

Based on Table 3, chemistry worksheet bilingual that developed can be said to have met the feasibility criteria of presentation according to BSNP [10] because having an assessment of ≥ 51% [9]. The percentage of presentation feasibility criteria respectively for each chemistry worksheet is 84,26%; 86,11%; 83,33%; and 84,26%.

The validation result indicate that chemistry worksheet bilingual that developed has been met the presentation criteria for all aspects that studied include : cover present the content of chemistry worksheet bilingual, clarity of indicators that will be achieved, presentation of chemistry worksheet bilingual awaken motivation and curiosity, suitability of illustration or images can help the concepts understanding, presentation of images accompanied with reference. It means illustration or images that presented in chemistry worksheet bilingual is suitable with concepts that explained by the proportional size and shape and equipped by appropriate descriptions [11]. Presentation of topic is student centered or encourage students to involved actively, presenting chemistry worksheet bilingual exciting or entertaining. Topic in this worksheet interactive and participative that motivates students to involved mentally and emotionally in the achievement of Standard Competence (SK) and Basic Competence (KD) [11]. The last aspect is references written suitable with usual rules.

Based on the validation result, chemistry worksheet bilingual that developed can be said to have met the feasibility criteria of language according to BSNP [10] because having an assessment of ≥ 51% [9]. The

percentage of language feasibility respectively for each chemistry worksheet is 75%, 95%,85%, and 85%.

This validation result indicate that chemistry worksheet bilingual that developed has been met the language criteria for all aspects that studied include : writing of chemistry worksheet bilingual using the appropriate language to developmental level of students. It means the language that used can explain the concepts or application of concepts that describe a concrete examples (which can be found by students) until abstract examples (which can imagined by students) [11], using good and proper the English language, using appropriate and easily understood terms, using steady terms or symbol, harmony of language or fused between chapters, sub-chapters, paragraphs, and sentences.

Based on the validation result that presented in Table 3, chemistry worksheet bilingual that developed can be said to have met the feasibility criteria of graphisity according to BSNP [10] because having an assessment of ≥ 51% [9]. The percentage of graphisity feasibility criteria respectively for each chemistry worksheet is 89,29%; 89,29%; 85,71%; and 85,71%.

This validation result indicate that chemistry worksheet bilingual that developed has been met the graphisity criteria for all aspects that studied include : front and back cover of chemistry worksheet bilingual is prominently displayed, contrast, interesting and suitable with kinds and size of fonts, illustrations, color, and layout, topic of chemistry worksheet bilingual that presented in texts and illustration shown are communicative, matching, proportional, and consistent, suitability of fonts selection (kinds and size), illustration of chemistry worksheet presented in an appropriate form and color, clarity of content printed can help the students to learn, understand, and absorb the information that submitted, paper that used is A4 paper 100 grams with function as printed media informing and survive at least until 5 years, and binding system 'soft cover' have a strength to survive at least until 5 years [12].

CONCLUSION

Based on the analysis of research data, it can be concluded that chemistry worksheet bilingual with Learning Cycle 7-E orientation in the reaction rate topic for beginner international senior high school was feasible used as supporting learning because it has reached a percentage of ≥ 51% for each the feasibility criteria that include criteria of content respectively from worksheet 1, 2, 3, and 4 is 88,89%; 93,06%; 86,11%; and 84,72%, suitability with Learning Cycle 7-E model is 89,39%; 89,39%; 86,36%; and 87,88%, presentation criteria is 84,26; 86,11%; 83,33%; and 84,26%, language criteria is 75%; 95%; 85; and 85%, and graphisity criteria is 89,29%; 89,29%; 85,71%; and 85,71%.

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