Unesa Journal of Chemical Education *ISSN: 2252-9454*
Vol. 6 No. 1, pp. 66-73 January 2017

THE DEVELOPMENT OF STUDENT WORKSHEET WITH CONTEXTUAL TEACHING AND LEARNING ORIENTED ON THERMOCHEMICAL MATTER TO TRAIN STUDENT CRITICAL THINKING SKILL

Dzalilah Zharva Livia Asri, Dian Novita and Bertha Yonata
Chemisty Department, FMIPA, Universitas Negeri Surabaya
email: dzalilahlivia@gmail.com. Mobile phone : 082335486460

Abstract

The study was aimed to know the feasibility of Student Worksheet with Contextual Teaching and Learning oriented on thermochemical matter to train student critical thinking skill. The feasibility of student worksheet was viewed according theoretically and empirically feasibility. Theoretically feasibility based on validation result. Empirically feasibility based on student's respond supported by students activities. This research use Research and Development (R&D) method, but constrain until test phase. Instruments that used in this research are review sheet, validation sheet, student respond sheet, and observation sheet. Data results was analyzed by descriptive quantitative method to know the feasibility both theoretically and empirically. Student worksheet was tested to 20 student of XII *MIA* 6 *SMA Negeri* 11 Surabaya to know the student's response. Based on the result, the research can be conclude that the student worksheet is feasible to be used. Validation result shows percentage of content criteria is 87.18% presenting criteria is 88.33%; and language criteria is 84.03%. Based on empirical feasibility show that student response to the worksheet to the some criteria which is, content criteria 89.06%; presenting criteria 85%; and language criteria 87.5%.

Keyword: Student worksheet, Contextual Teaching and Learning, Thermochemical, Student Critical Thinking Skil

INTRODUCTION

One of the problem that faced by educational institutions in Indonesia, is the low quality of education. Education system in Indonesia prefer the value as a benchmark of success, and tend to forget the social and psychomotor aspects as the education goals as well. Therefore, it is necessary to improve the quality of education that conducted continuously and systematically. According to *Undang-Undang No. 20 Tahun 2013* on National Education System, National Education serves to develop skills and character development and civilization of the nation's dignity in the context of the intellectual life of the nation and is aimed at developing students' potentials in order to become a man of faith and fear of God Almighty, noble, and become citizens of a democratic and responsible responsibility [1].

The learning process in schools today are more likely to teacher center, where the teacher as the main source of knowledge without giving an opportunity for students to interpret their knowledge with the development of science and technology, human thought must also be developed as well. Critical thinking is one of the capabilities of High Order Thinking Skills (HOTS) [2]. Critical thinking skills should be trained early in the school through a learning process. According to *Permendikbud No. 20 Tahun 2016* on Standard Competency of Graduates for high school states that a high school

graduate should has the skills to think and act creatively, productive, critical, independent, collaborative and communicative through a scientific approach as the development of the study in educational units and other sources independently [3]. Critical thinking skills required by students as the basis for understanding many things, including understanding the concepts in the disciplines [4].

Student worksheet can be used as alternative source of learning, and an instructional media that can be used by teachers in teaching activities. The development of student worksheet should be considered in learning principles. Learning principles are: easy to understand the difficulties; repetition would be reinforce student understanding; high motivation to learn is one of many success factors of learning, achieving was like climbing stairs, step by step, but will eventually reach a certain height; the results will encourage students to continue to reach their goals [5].

Various approaches can be used to train students' critical thinking skills, one of them through the CTL approach (Contextual Teaching and Learning). Muchlis [6] has already conducted a research about CTL and conclude that CTL approach can improve student critical thinking skills and students' motivation [6]. The principles and practices of Contextual Teaching and Learning are: a) enable teachers to relate subject matter learning to settings where it is used in real life at home, work, and the community; and b) help students transfer knowledge and problem solving skills learned in school to other life contexts as well to help them prepare future careers, citizenship, or continued learning [7]. Component of Contextual Teaching and Learning including: (1) constructivism, (2) questioning, (3) inquiry, (4) learning community, (5) modeling, (6) reflection, and (7) authentic assessment [8]. Various studies have shown that CTL approach can improve students 'critical thinking skills and improve students' motivation.

Based on the facts in *SMA Negeri* 11 Surabaya shows that the student worksheets that used nowadays are less innovation and only contains practice questions and less attention to social and psychomotor aspects. One of teacher in *SMAN* 11 Surabaya stated that the learning process in classroom tend to be information transfer from teachers to students, because most teachers used the teacher center model in learning process and only certain material used student worksheet. Based on the pre-study data showed that 70% of students said that the worksheet they used are less training critical thinking and 80% of students said student worksheet they used did not connect the material with phenomenon in everyday life. Percentage mastering learning of student critical thinking also still low in each component.

Thermochemical included in the sub microscopic materials that are difficult to learn, so the student's value tend to be low. The value for thermochemical materials is relatively low, 52% students got score below minimum score. Therefore, needs to study about, "Development of student worksheet with Contextual Teaching and Learning oriented on thermochemical matter to train student critical thinking skill."

METHOD

The research of development student worksheet oriented by Contextual Teaching and Learning had been developed refers to Research and Development (R&D). There are 10 steps in the development, which are: potential and problem, collecting data, product design, validation of design, design revisions, limited trial, product revisions, utility testing, product revisions, and production

[9]. However, the research only testing the feasibility of student worksheet so the stages is limited to sixth step, namely limited trial.

Source of the data in this research came from three sources. First, data review was derived from two lecturers and one chemistry teacher. Second, data validation was derived from one lecturer and two chemistry teachers. And the third, test result of 20 students of class XII *MIA* 6 *SMAN* 11 Surabaya.

The instruments used in this research are as follows:

1. Review Sheet

Data review sheet was analyzed descriptive qualitatively to provide an overview and suggestion that given by chemistry lecturer and chemistry teacher related to criteria of feasibility of student worksheet.

2. Validation Sheet

Analysis of validation sheet is performed against three criteria: content, presenting and language. Percentage of data obtained using a Likert scale present in Table 1.

Table 1. Likert Scale

Criteria	Score
Not Good	0
Less Good	1
Good Enough	2
Good	3
Very Good	4

[10]

Percentage data are calculated by formula:

$$P(\%) = \frac{total\ score\ of\ collecting\ data\ result}{Criteria\ score} x100\%$$

with description:

Criteria score = highest score x number of questions x number of respondents.

The results of the validation sheet analysis is used to determine the feasibility of student worksheet using Likert interpretation scored as follows in Table 2:

Table 2. Likert Scale Score Interpretation

Percentage (%)	Criteria
0-20	Very poor
21-40	Poor
41-60	Quite
61-80	Good/Appropriate
81-100	Very Good/ Very Appropriate

[10]

Based on the Likert scale score interpretation, student worksheet are feasible if the percentage ≥ 61% or in good or appropriate criteria. So the student worksheet are feasible theoretically.

3. Questionnaire responses

Analysis for student responses questionnaire is using Guttman scale criteria. Guttman scale is used to answer a clear and consistent, which is given a score of 1 if yes and a score of 0 if not. Student questionnaire was made in the form of "yes" or "no".

Table 3. Guttman Scale

Answer	Score
Yes	1
No	0

[10]

Then, the percentage calculation used formula below:

$$P(\%) = \frac{F}{N} x100\%$$

Where:

P = response answer

F = total "yes" answer

N = total respondents

Based on Table 2, student worksheet is feasible empirically if percentage that obtained ≥ 61%.

4. Observation sheet of student activity

Observation sheet is an instrument used to determine student activity during learning process. From this observation sheet can be seen that each of student have been working for each component in student worksheet with Contextual Teaching and Learning oriented. This data support the feasibility of develop student worksheet.

RESULT AND DISCUSSION

Theoretical feasibility

Student worksheet was reviewed by two chemistry lecturers and one chemistry teacher to get advice and suggestions on the draft I. Draft I later revised to produce draft II to be validated and tested. Feasibility theoretically of student worksheet can be known from validation result on content criteria, presenting criteria, and language criteria.

One chemistry lecturer and two chemistry teachers assessed the worksheet by using validation sheet. Result of validation of student worksheet with Contextual Teaching and Learning oriented is presented in Table 5.

Table 5. Validation Result

No	Criteria	Percen-tage	Category
1	Content	87.18%	Very Appropriate
2	Present-ation	88.33%	Very Appropriate
3	Langua-ge	84.03%	Very Appropriate

Based on the validation result known that percentage of content criteria of student worksheet with Contextual Teaching and Learning oriented get the percentage 87.18%. Based on the Likert score interpretation in Table 2, content criteria has a very appropriate criteria. These result indicates that developed student worksheet comply the eligibility content criteria based on the content of Instructional Materials Development Guide [12]. The eligibility of content criteria include the suitability of the material with core competence (*KI*) and basic competence (*KD*), learning objectives, level of student cognition and organization of material follows the schematic science. In addition, content criteria also includes suitability with the component of Contextual Teaching and Learning. The component are: learning community, questioning, constructivism, and reflection. Learning community can occur when two-way communication is established, two or more groups involved in learning communication [13]. Implementation of learning community can be done by applying learning in a group. Questioning component in student worksheet will encourage and motivate students to explore information through formulating the question from the phenomenon that has been presented. Questioning is seen as a reflection of curiosity every individu, so it will motivate students to learn more. Constructivism in student worksheet will encourage student to construct their knowledge through observation of phenomenon and their personal experience. Through constructivism, student can associate the content of subject such as math, science and history with their experience, students can find the meaning, and it gives student a reason to learn [8]. Reflection is an important component of every learning. Through reflection, a learning experience will be included in a student's cognitive structure that will eventually become a part of the knowledge. The content criteria also includes suitability of critical thinking skill component which consist of: giving a simple explanation by formulating questions; establish basic skill through report an observation results; concluded by make a conclusion based on the facts and investigation results; giving further explanation by making a definition; and set the strategies through repetition [14].

Based on the validation result, the percentage of presenting criteria of student worksheet with Contextual Teaching and Learning oriented is 88.33%. Based on Likert score interpretation, presenting criteria has a very appropriate criteria. These result indicates that developed student worksheet comply the eligibility content criteria based on the content of Instructional Materials Development Guide [12]. Presenting criteria include:

compliance with the concept; presentation of illustration or images must be relevant to the subject matter; variance and interesting display; provide enough space for student to give their answer; and completeness of presentation such as: introduction, table of content, bibliography, concept maps, purpose, and guided. Concept presented a coherent, consistent, and balanced between sub-chapter. Student worksheet arranged in a coherent, consistent, and balanced between sub-chapters. Sub-chapter are arranged orderly start from system and surrounding to change the value of the enthalpy reaction. Compared with other component, presentation of illustration got the lowest score but still in good category. Providing of enough space for student to give an answer; and completeness of presentation obtain high score. Both components are classified as category very appropriate, thus proving that the student worksheets developed by the presentation of a complete and provides enough space for the student's answers.

Based on the validation result, the percentage of language criteria of student worksheet with Contextual Teaching and Learning oriented is 84.03%. Based on Likert score interpretation, presenting criteria has a very appropriate criteria. Language criteria include: using appropriate language; using language in accordance with maturity level of student; use a clear sentence structure; and using communicative language. Based on the observation result, student in class XII *MIA* 6 of *SMAN* 11 Surabaya are 17-18 years old. According to Piaget's theory of cognitive development, they included at the stage of development of formal operations. So, the language that used in the worksheet must appropriate with their stage of cognitive development.

Based on three criteria, content criteria, presenting criteria and language criteria can be seen that student worksheet with Contextual Teaching and Learning oriented are theoretically feasible. Because each criteria get the percentage ≥ 61%.

Empirical feasibility

Empirical feasibility is obtained from student responses and observation sheet.

1. Student Responses

The results obtained from student response to student worksheet with Contextual Teaching and Learning oriented on thermochemical matter. Data of student's response are presented in Table 6.

Table 6. Student's Response Result

No	Criteria	Percen-tage	Category
1	Content	89.06%	Very Appropriate
2	Present-ation	85%	Very Appropriate
3	Langua-ge	87.5%	Very Appropriate

Based on the Table 6, student responded to the content criteria is 89.06%. It shows that student very responsive to the developed worksheet. Students stated that the questions and explanations in the worksheet are easy to understand. The issue present in accordance with their level of development, so assist student studying thermochemical material. Student worksheet also makes students can work in group, asking question, constructing material, and reflecting materials. Student were able to connect the material with phenomena that occur in everyday life. Students also stated that the worksheet can help student to think critically through formulating question, report the result of observation, make a conclusion and definition, and repeating a material. It was proven by test result of student's critical thinking skill.

The result of student response to presenting criteria has gained percentage 85%. It shows that student very responsive to the developed worksheet. The

presentation of student worksheet has a complete presentation such as writing is clearly legible, attract student to use worksheet, and provide enough space to work.

In addition, the result of student response to language criteria get percentage of 87.5%. It shows that student very responsive to the developed worksheet. Worksheet developed already accordance to student cognition, using appropriate language, clear sentence structure and easy to understand.

Based on the result of student response, can be seen that student worksheet with Contextual Teaching and Learning oriented are feasible. Because each criteria get the percentage ≥ 61%.

2. Observation Sheet

The result of student activity is presented in figure 1.

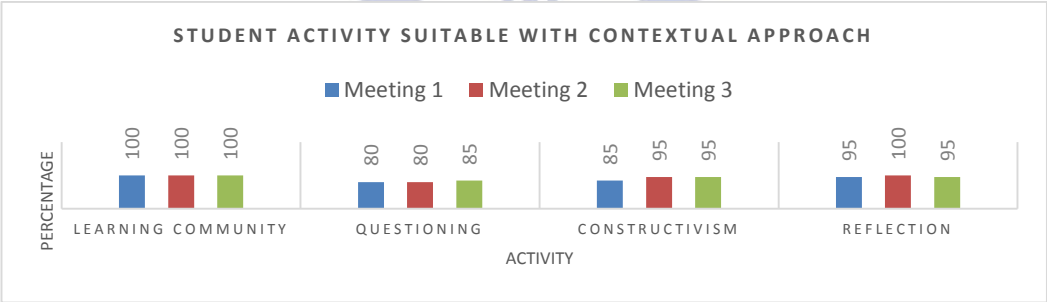

Figure 1 Graph of student activity suitable with Contextual Teaching and Learning

Based on Figure 1, the observation of student activity shows that student actively involved in learning process that suitable with contextual approach although the graph shows fluctuation in every meeting. It caused by the difficulties faced by student in some component. Questioning shows the lowest score than the other component. It indicates that student must practice more to master that component. Learning community get percentage 100%, it indicates that all students make a group during learning activity. Collaborating helps students identify, design plans, and explore solutions. Collaborating helps them discover that listening to one another leads to success [8]. Students also can construct the knowledge while doing constructivism and reflect what they already learn while doing reflection.

Result of student activity is presented in Picture 2.

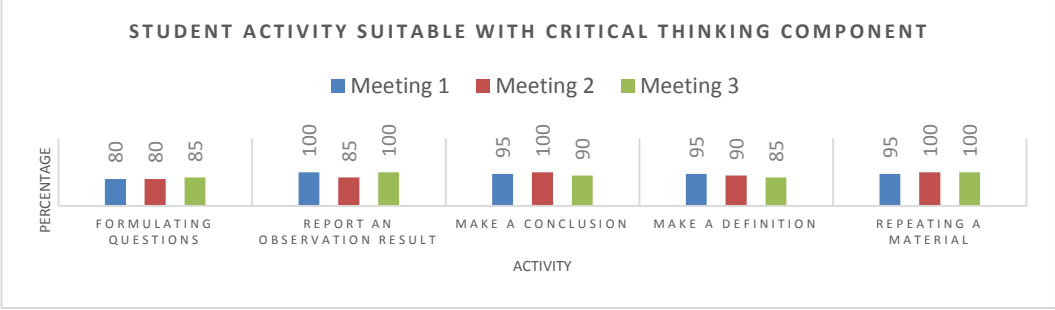

Figure 2 Graph of student activity suitable with Critical Thinking Skill Component

Based on Figure 2 the observation of student activity shows that student actively involved in learning process which suitable to critical thinking skill component although the graph shows fluctuation in every meeting. It caused by the difficulties faced by student in mastering the component. Formulating question shows the lowest score than the other component. It indicates that student need more practice to formulate question. To be successful, independent learners need to be able to ask interesting question. Formulating question require higher order thinking skills which is applying, analyzing and evaluating [15]. Student will automatically acquire these abilities while they participate in a self-regulated learning task. Imama [16] conducted an experiment and obtained result where formulating question get lowest score than the other component. It shows that formulating question is the difficult component and need to be trained more than three times.

Formulating question needs to be trained to student because good questions give rise to meaningful task and to be the thoughtful in investigation that guides students as they gather and assess information. From the observation sheet it can be conclude that student worksheet with Contextual Teaching and Learning oriented can train student to think critically.

Based on the students response and supported by observation of student activity can be seen that student worksheet with Contextual Teaching and Learning oriented are empirically feasible.

CLOSURE

Conclusion

Based on results of the research and discussion can be concluded that:

1. Student worksheet with Contextual Teaching and Learning oriented on thermochemical matter is theoretically feasible. It proved by validation result of content criteria of 87.18% (Very Appropriate); presenting criteria of 88.33% (Very Appropriate); and language criteria of 84.03% (Very Appropriate).
2. Student worksheet with Contextual Teaching and Learning oriented on thermochemical matter is empirically feasible. Based on the student's responses shows student response to the content: criteria of 89.06% (Very Appropriate), presenting of 85% (Very Appropriate), and language of 87.5% (Very Appropriate).

Suggestion

1. Sentence structure of student worksheet with Contextual Teaching and Learning oriented on thermochemical need to be rechecked the effectiveness sentence structure, so further research expected to develop worksheet with better sentence structure.
2. Design of student worksheet with Contextual Teaching and Learning oriented on thermochemical need more picture that could represent worksheet activities to attract student to learn more. Future researched are expected to develop student worksheet with more interesting and motivate student to learn more.

REFERENCES

1. _____. 2003. Undang-Undang Republik Indonesia No. 20 tahun 2003 Tentang Sistem Pendidikan Nasional. Jakarta: Kementrian Republik Indonesia.
2. Sutrisno. 2012. *Kreatif Mengembangkan Aktivitas Pembelajaran Berbasis TIK.* Jakarta : Referensi.
3. Kemendikbud. 2016. *Permendikbud nomor 20 tahun 2016 tentang Standar Kompetensi Lulusan Pendidikan*

4. *Dasar dan Menengah*. Jakarta: Kemendikbud.

5. Kartimi dan Liliasari. 2012. "Implementasi Pengembangan Alat Ukur Berpikir Kritis Pada Konsep Kesetimbangan Kimia Untuk Siswa SMA". *Jurnal Scientiae Educatia Volume 1 Edisi 2*.

6. Depdiknas. 2008. *Panduan Pengembangan Materi Pembelajaran dan Standar Sarana dan Prasarana Sekolah Menengah Kejuruan Madrasah Aliyah SMA/MA/SMK/MAK*. Jakarta: Depdiknas.

7. Muchlis. 2015. Model-Model Pembelajaran yang Sukses Melatihkan Keterampilan Berpikir Kritis. *Prosiding Seminar Nasional Kimia, ISBN: 978-602-0951-05-8*, Jurusan Kimia FMIPA Universitas Negeri Surabaya.

8. Smith, Bettye P. 2010. "Instructional Strategies in Family and Consumer Sciences: Implementing the Contextual Teaching and Learning Pedagogical Model". *Journal of Family & Consumer Sciences Education*, 28(1), 2010.

9. Johnson, Elaine B. 2002. *Contextual Teaching and Learning*. California: Crowin Press.

10. Sugiyono. 2013. *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D.* Bandung: Alfabeta.

11. Riduwan. 2012. *Skala Pengukuran Variavel-Variabel Penelitian.* Bandung: Alfabeta.

12. Kemendikbud. 2014. P*ermendikbud nomor 104 tahun 2014 tentang Penilaian Hasil Belajar Oleh Pendidik Pada Pendidikan Dasar dan Pendidikan Menengah.* Jakarta: Kemendikbud.

13. Badan Standar Nasional Pendidikan (BSNP). 2006. *Instrumen Penilaian Tahap II BukuTeks Pelajaran Kimia SMA/MA.* Jakarta: Badan Standar Nasional Pendidikan.

14. Sanjaya, Wina. 2011. *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan*. Jakarta: Kencana.

15. Ennis, Robert Hugh. 1996. *Critical Thinking*. New Jersey: Prentice Hall.

16. Stobaugh, Rebecca. 2013. *Assessing Critical Thinking in Middle and High Schools*. New York: Eye On Education.

17. Imama, Nur. 2013. "Penerapan Model Pembelajaran Inkuiri Untuk Melatihkan Keterampilan Berpikir Kritis Siswa Melalui Laju Reaksi di Keals XI SMAN Sreseh Sampang". *Unesa Journal of Chemical Education.* Vol 4 (2): pp 212-217.