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DEVELOPMENT OF CHEMISTRY STUDENT WORKSHEET ON ATOMS, IONS, AND MOLECULES TOPIC WITH LEARNING CYCLE 7-E ORIENTATION FOR PIONEER INTERNATIONAL JUNIOR HIGH SCHOOL

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Abstract: The research of development Chemistry Student Worksheet on Atoms, Ions, and Molecules topic with learning Cycle 7-E orientation for Pioneer International Junior High School have been done to know the feasibility of Chemistry student Worksheet based on criteria of content, presentation, suitability with Learning Cycle 7-E, language, graphical, and student response. This research design is based on R&D method which limited in development phase, in development phase using modified 4- D models. Instrument that used are analyze (review), validation, and student response questionnaire sheets. Validation was done by 2 chemistry lectures and 1 science teacher. Limited testing of Chemistry student Worksheet was done to 12 students of VIII-1 SMP Al-Falah Sidoarjo. Collecting data was done by questionnaire method. Analyze of data was done descriptive quantitatively. The result showed that Chemistry Student Worksheet with learning cycle 7-E orientation feasible based on the appraisal from appraiser and student's response ≥ 51%. The assessment for content 77,38%; 78,57%; and 79,76%; presentation, 80,95%; 80,95%; dan 80,95%; suitability with Learning Cycle 7-E, 75%; 75%; dan 75%; language, 73,33%; 73,33%; dan 73,33%; and graphical 79,16%; 80,56%; dan 80,09%. Students give positive response to chemistry student worksheet that has been developed.
Key words : development research; chemistry student worksheet; learning cycle 7-E; Atoms, Ions, and Molecules.

Abstrak : *Penelitian pengembangan Chemistry Student Worksheet pada materi Atom, Ion, Molekul berorientasi model Learning Cycle 7-E untuk SMP RSBI telah dilakukan dengan tujuan untuk mengetahui kelayakan Chemistry Student Worksheet berdasarkan kriteria isi, penyajian, kesesuaian dengan model Learning Cycle 7-E, kebahasaan, kegrafikaan dan respon siswa. Rancangan penelitian mengacu pada Research and Development (R&D) dan dibatasi sampai tahap pengembangan. Pada tahap pengembangan menggunakan desain 4-D models yang dibatasi sampai tahap develop. Instrumen yang digunakan adalah lembar telaah, lembar validasi, dan lembar angket respon siswa. Validasi dilakukan oleh 2 dosen kimia dan 1 guru IPA SMP. Uji coba terbatas dilakukan terhadap 12 siswa kelas VIII-1 SMP Al-Falah Deltasari Sidoarjo. Pengumpulan data menggunakan metode angket. Metode analisis data dilakukan secara deskriptif kuantitatif. Hasil penelitian menunjukkan bahwa Chemistry Student Worksheet berorientasi model Learning Cycle 7-E layak berdasarkan penilaian dari validator dan respon siswa sebesar ≥ 51. Penilaian validator terhadap Chemistry Student Worksheet 1, 2, dan 3 untuk kriteria isi sebesar 77,38%; 78,57%; dan 79,76%; penyajian 80,95%; 80,95%; dan 80,95%; kesesuaian dengan model Learning Cycle 7-E 75%; 75%; dan 75%; kebahasaan 73,33%; 73,33%; dan 73,33%; dan kegrafikaan 79,16%; 80,56%; dan 80,09%. Penilaian siswa terhadap Chemistry Student Worksheet ditunjukkan dengan respon positif dari siswa.*

Kata kunci : *penelitian pengembangan; chemistry student worksheet; learning cycle 7-E; Atom, Ion, dan Molekul*

INTRODUCTION

Indonesia's education evolves over time toward a better direction. Learn from the development of education in developed countries, Indonesia is also doing similar developments, such as curriculum development in Indonesia that has changed from the curriculum of *Cara Belajar Siswa Aktif (CBSA)* to *Kurikulum Berbasis Kompetensi (KBK)* and now *Kurikulum Tingkat Satuan Pendidikan (KTSP).* Government has implemented *KTSP* in an effort to improve the quality of human resources since 2006. *KTSP* recommended that all activities expect student-centered learning, so that students are expected to construct knowledge / understanding by their own.

Schools quality in Indonesia also began to grow, ranging from national to international school level. Started in 2007, Government through the Directorate of Primary and Secondary Education Directorate Secondary School, in order to improve the quality of education to develop schools that already as the national educational standards to pioneer international school and became international school. International school conducted a thorough development, including curriculum, textbooks, dictionaries, teaching guidelines, lesson plans, instructional media, and the assessment guidelines [1].

In this regard, the government adopted a policy as set forth in Law Number 20 of 2003 on National Education System Article 50 paragraph (3) which states that *"Pemerintah dan/atau Pemerintah Daerah menyelenggarakan sekurang-kurangnya satu satuan pendidikan pada semua jenjang pendidikan untuk dikembangkan menjadi satuan pendidikan bertaraf internasional"*. In *Pedoman Penjaminan Mutu Sekolah Bertaraf Internasional pada Jenjang Pendidikan Dasar dan Menengah* [2] stated that international schools are schools that have met all National Education Standards and enriched by reference to the standard of education is one of the members of the *Organization for Economic Co-operation and Development* (OECD) and / or other countries that have certain excellent in education, so it has a competitive edge in international forums.

SMP Al-Falah Deltasari Sidoarjo is one of the pioneer international school *(RSBI)* which this year has entered the fourth year as pioneer international school have been using *bilingual* method in science learning process.

Nowadays there are many science books in English or *bilingual* are available for international schools, such as science books from *Esis, Tiga Serangkai , Erlangga* publishers and science books from the *Direktorat Pembinaan SMP-SBI.* Meanwhile, the English worksheet for SMP has not been widely provided on the market.

Student worksheet is sheets contains task to be done by learners. Worksheet are usually consists of instructions, the steps to complete a task. Tasks contained in the worksheet should have clear basic competence to be achieved [3].

Depdiknas [3] states that the student worksheet will provide benefits for teachers and students. Teachers will have ready materials for use, while students will gain experience of independent study and learn to understand the written task contained in worksheet. So the availability of learning materials such as worksheet is also very necessary to support learning activities.

Depdiknas [3] and *BSNP* [4] explain that the good student worksheet is student worksheet that applied the feasibility criteria of content, presentation, language, and graphical. Based on survey results and interviews with science teacher in *SMP Al-Falah Deltasari Sidoarjo*, student worksheet have been used in that school which was made by the teacher consist of the title of worksheet, standard of competence, basic competence, indicators and evaluation provided in each meeting that must be done by students. Based on *Depdiknas* [3] and *BSNP* [4], the good student worksheet should fulfill criteria of content, presentation, language, and graphical. According to Achmadi in Aini [5] the requirement of good student worksheet are form should be interesting, the language appropriated with the student's developmental level; have clearly description of the material; instruction of using is easy to follow and to encourage active student. In addition, teachers also stated that the student worksheet available in the market is less suitable

if used directly in the study because of lack of fit with the lesson plans created by teachers. The necessary of student worksheet in English as a learning source in teaching and learning activities supported by the results of field studies on November 1st 2011 through the dissemination of questionnaire to 25 students of *SMP Al-Falah Deltasari* Sidoarjo, 60% of respondents stated required to develop an interesting worksheet in English which contains summary of the material (92%), *full color* (100%), interesting picture (92%), along with examples related to daily life (80%), accompanied by practical activities (64%), and equipped with the evaluation (84%).

Science material for *SMP-SBI* is a continuation of study materials science in elementary school which includes four aspects, namely: living things and life processes, matter and its properties, energy and change, earth and universe [1]. One of the materials included in the scope of matter and its properties is Atoms, Ions, and Molecules matter that given in grade VIII Semester 1 with standard of competence understanding the meaning of particles of matter and basic competence are describing the atoms, ions, and molecules; comparing the molecular elements and molecular compounds; and identifying the benefits of ions and molecules in chemical products daily life. Based on the results of field studies, 68% of students stated that Atoms, Ions, molecules is a difficult matter. To achieve the basic competence that has been mentioned, learning sources and teaching models that suitable with the characteristics of the material is required. One of model that corresponds to that basic competence is Learning Cycle 7-E model.

Learning Cycle 7-E is a learning model based on constructivist paradigm of learning or student-centered learning with a series of stages of activities (phase) which organized in such a way that students can master the competence that must be achieved in the learning by plays an active role. Learning Cycle 7-E model is suitable used in teaching that involves many concepts, principles, rules and mathematical calculations [6]. Atoms, ions, and molecules is a material that learn a lot of concept, so learning cycle 7-E is suitable to be applied in teaching through the use of student worksheet for such material to motivate students to find their own understanding so that students not only memorize the abstract concepts but rather can construct their own concept for them.

In contrast to other learning models, the activity in learning cycle 7E is more determined by the students, so students are more active. Learning cycle 7-E model is the development of learning cycle 5E model. The developed phase is in engage phases into two components, namely elicit and engage, while in the elaborate and evaluate phase into three phases, namely elaborate, evaluate, and extend as shown in Figure 1 [7].

According to Huang (2008) in Kusumaningsih [6] learning cycle 7E model also has advantages such as stimulating the students to recall the material they have acquired previously; provide motivation for students to become more active and add a sense of curiosity; train students learn to discover concepts through experiment; coached students to communicate verbally concepts they have learned; provide an opportunity for students to think, search, find and explain examples of application of the concepts that have been studied; teachers and students held the stages of learning that complement each other woods; teachers can implement this model with different methods.

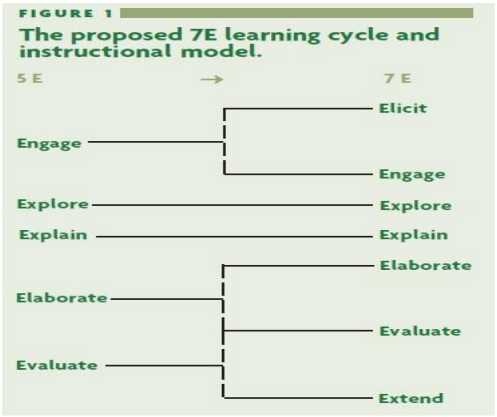


Figure1. The changes of Learning Cycle 5E into 7E.

Source: Eisenkraft,A. 2003. *Expanding the 5E Model. The sciences Teacher* 70 (6).56-59

Based on the background mentioned above, the researchers want to develop a Chemistry Student Worksheet in Atoms, Ions, and Molecules topic with learning cycle 7E orientation as a learning source in order to facilitate students' learning invented the concept independently, therefore, held research entitled " Development of Chemistry Student Worksheet on Atoms, Ions, And Molecules Topic With Learning Cycle 7-E Orientation For Pioneer International Junior High School ".

Based on the background above, the problem formulation in this research is "How the feasibility of chemistry student worksheet on atoms, ions, and molecule topic with learning cycle 7E orientation assessed based on criteria of content, presentation, suitability with the learning cycle 7-E model, language, graphical, and student responses?

In accordance with the problem formulation that mentioned, the objective of this research was to know the feasibility of developed Chemistry Student Worksheet based on the criteria of content, presentation, suitability with learning cycle 7E model, language, graphical, and student response.

The benefits that expected from this research there are: researchers have insight on the development of Chemistry Student Worksheet that can be used as a reference for developing teaching materials on another topic, grade, or education level; can be used by teacher in teaching the material atom, ion, molecule for pioneer international junior high school; as a learning source that can motivate students in learning, helping students understand the subject matter of atoms, ions, and molecules.

RESEARCH METHODS

The Type of this research is development research. The development of Chemistry Student Worksheet on Atoms, Ions, and Molecules topic with learning cycle 7E orientation is refer to Research and Development (R&D) method. It consists of three stages, namely stage of preliminary studies phase, development study phase, and the evaluation phase [8]. But in this study is limited in development phase. In development phase using four D model (4-D) that was suggested by Thiagarajan, Semmel, and Semmel (1974) in Ibrahim [9] which consists of four steps that are define (definition), design (design), develop (development), and disseminate (dissemination). This research is limited in develop steps. Targets in this research is Chemistry Student Worksheet on atoms, ions, and molecules topic with learning cycle 7-E orientation for pioneer international junior high school which then would be reviewed by two experts of matter, one expert of English, and one media expert from Unesa's Chemistry lectures using the instrument review sheets. Validation is done by two lectures of Chemistry Unesa and one science teacher of SMP Al-Falah Deltasari Sidoarjo to know the feasibility of Chemistry Student Worksheet that was developed using the validation sheet instrument. Analyze of data done by descriptive quantitative method. The percentage of the data obtained is based on Likert scale calculation as shown in Table 1.

Table 1 Likert Scale

Appraisal	Value Scale
Very Poor	1
Less	2
Good	3
Very Good	4

Adaptation of Riduwan [10]

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

$$P(\%) = \frac{\sum \text{score result of collecting data}}{\text{score of criteria}} \text{x} 100\%$$

With P = percentage

Score of criteria = highest score x Number of aspects of x number of respondents

The results of the validation sheet analysis used to determine the feasibility of Chemistry Student Worksheet that has been developed by using the interpretation of scores as shown in Table 2.

Table 2 Criteria of Score Interpretation

Percentage (%)	Criteria
0-25	Very poor
26-50	Poor
51-75	Good / feasible

76-100	Very good / very feasible

Adaptation from Riduwan [10]

Assessment by students is done through filling the student response questionnaire. Percentage of data obtained by questionnaire is calculated based on Guttman scale in Table 3.

Table 3 Gutmann Scale

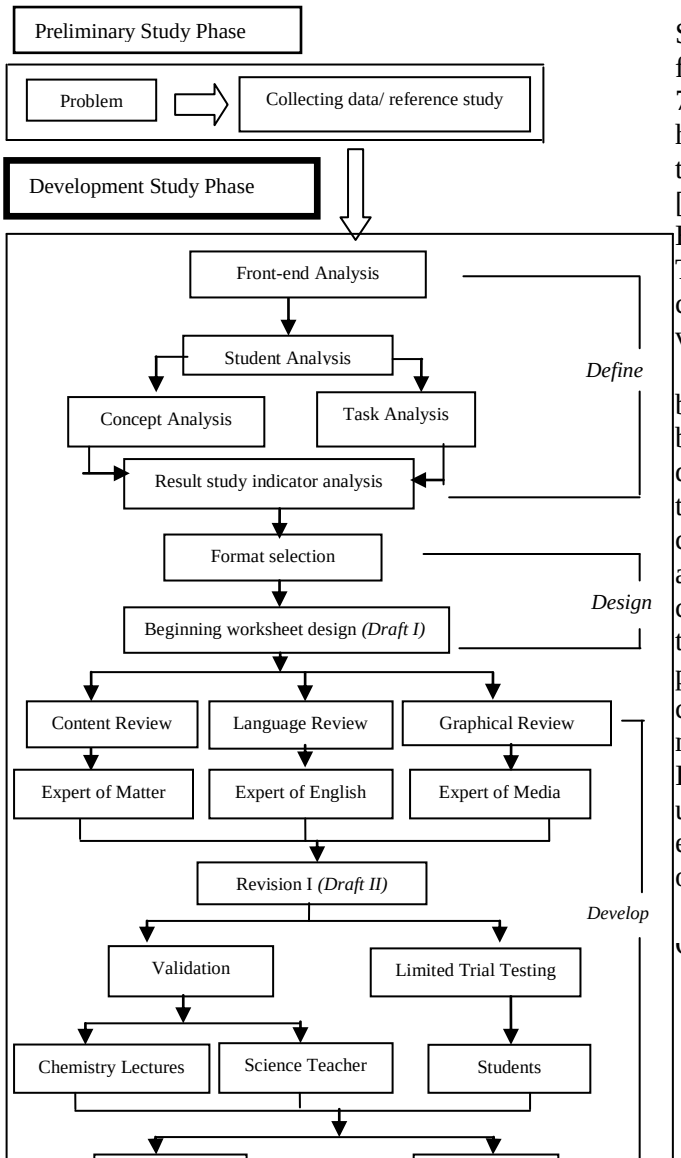
Answer	Score
Yes	1
No	0

Riduwan [10]

The formula used to obtain the percentage of the equation:

$$P(\%) = \frac{\sum \text{score result of collecting data}}{\text{score of criteria}} \times 100\%$$

Research design of this Chemistry Student Worksheet Development is shown in Figure 2.



RESULTS AND DISCUSSION

Data assessment of Chemistry Student Worksheet by appraiser then analyzed descriptive quantitatively. Validation results of Chemistry student worksheet are presented in Table 3.

Chemistry Student Worksheet is said feasible if it satisfies the percentage of 51%-75% and is very feasible if the percentage is 76%-100% [10].

The validation results of Chemistry Student Worksheet based on criteria of content for *worksheet* 1, 2, and 3 respectively by 77.38%, 78.57% and 79.76%. These results have satisfied the feasibility criteria for content that was adapted from *Depdiknas* [3] and *BSNP* [4] because it has been achieve $\geq$ 51% [10]. Based on the criteria of score interpretation in Table 2, It can be said that the feasibility for criteria of contents worksheet 1, 2 and 3 are very feasible.

These validation results was obtained because chemistry student worksheet that has been developed satisfy the contents criteria that described in *Depdiknas* [3] and *BSNP* [4] that the material in accordance with the applicable curriculum for pioneer international high school; according to standard of competence and basic competence to be achieved; indicators relevant to learning outcomes; and the illustrations are presented in accordance with science facts and concepts described in this topic atoms, ions, and molecules proportionally to the size and shape. In addition, the evaluation questions is easy to understand and comply with the indicators; experimental activities accordance with standard of competence and basic competence that are developed. Therefore, based on content criteria, Chemistry Student Worksheet in atoms, ions,

and molecules topic with learning cycle 7-E orientation is very feasible.

The validation results of chemistry student worksheet based on presentation criteria of for worksheet 1, 2, and 3 are 80.95%. The results stated that the Chemistry Student Worksheet can be said feasible because it has achieve ≥ 51% [10]. Based on the criteria of score interpretation in Table 2, it can conclude the feasibility of presentation criteria for worksheet 1, 2, and 3 is very feasible.

Table 3 Validation Results of Chemistry Student Worksheet Learning Cycle 7E Orientation

No	Criteria	Assessment percentage (%)			Criteria
		CSW 1	*CSW 2*	*CSW 3*	
1.	Content	77.38	78,57	79,76	Very feasible
2.	Presentation	80,95	80,95	80,95	Very feasible
3.	Suitability with Learning cycle 7-E model	75	75	75	Feasible
4.	Language	73,33	73,33	73,33	Feasible
5	Graphical	79,16	80,56	80,56	Very Feasible

The presentation criteria is very feasible obtained because the general organization of the presentation; an introduction to the Chemistry Student Worksheet initial page that contains the purpose of writing, content, and how to use that must be followed are present simply and straightforward; conformity table of contents with chapter headings, sub-chapters, page numbers, clarity of learning objectives of each sub-chapter; presentation of Chemistry Student Worksheet are interactive and participatory so that motivate learners to learn independently (student-centered); presentation of Chemistry Student Worksheet can arouse the students curiosity; the completeness of the information contained in mini vocabulary can help students understand difficult words in Chemistry Student's Worksheet. Consistency in the systematic chemistry student worksheet has also been adapted to the criteria described in BSNP [4] is a systematic presentation of the material has been following the writing systematic of student worksheet from *Depdiknas* [3] which includes the title, learning instruction, competencies to be achieved, supporting information, the work steps, and evaluation. So based on presentation criteria, chemistry student worksheet in atoms, ions, and molecules topic with learning cycle 7E orientation is very feasible to used.

Chemistry student worksheet that was developed is said have satisfied the suitability with the component of learning cycle 7E model if it satisfy the criteria of suitability with the learning cycle 7E model that includes the phases of the learning cycle 7-E there are elicit, engage, explore, explain, elaborate, evaluate, and extend.

The validation results of chemistry student worksheet based on the suitability with learning cycle 7E criteria for each *worksheet* 1, 2, and 3 are 75%. The results stated that the Chemistry Student Worksheet can be said feasible because it has achieve ≥51% [10]. Based on the criteria of score interpretation in Table 2, it can be concluded the feasibility based on suitability with learning cycle 7E model for worksheet 1, 2, and 3 is feasible

Chemistry Student Worksheet that was developed presents some activities that packed in accordance with the phases in Learning Cycle 7-E, that suggested by Eisenkraft [7] where there in elicit phase students are given questions that should do individually to eliciting their prior knowledge of the material that will be studied. In engage phase, students are given several phenomena in daily life to motivate them toward the topic, after that in explore phase students are given the opportunity to work in small groups to gain direct experience of dealing with the concept of the topic. Activities that done by students in this phase such as group discussion and doing experiment. The results of the activities on the explore phase is further communicated by students in explain phase. After communicating the results or concepts that they get, the next activity is applying the concept in a new situation on the elaborate phase, this can be done by doing questions given individually in the elaborate phase, for the next

students are given the continued questions in the evaluation phase to evaluate the learning that has been done. If the evaluation results achieved, then goes to the next phase, extend which the aims to encourage students to connecting concepts that have been studied with another concepts, this can be done guided by giving reading materials that are accompanied by analytical questions. Based on the score interpretation criteria in Table 2, it can be said the criteria of suitability with learning cycle 7E model for Chemistry Student Worksheet is feasible.

The validation results of chemistry student worksheet based on language criteria for each worksheet 1, 2, and 3 are 73.33%. The results stated that the chemistry student worksheet can be said feasible because it has achieve ≥ 51% [10]. Based on the score interpretation criteria in Table 2, it can conclude the feasibility of language criteria for worksheet 1, 2, and 3 is feasible.

Components of language criteria are adapted from the *Depdiknas* [3] and *BSNP* [4] that the legibility of Chemistry Student Worksheet language using language appropriate to the level of student progress; Chemistry Student Worksheet writing in good and right English; harmonious in language or relation between chapters, sub chapters, paragraphs, and sentences; the writing of Chemistry Student Worksheet using terms that are easily understood; the writing of Chemistry Student Worksheet using the term, symbol, or emblem steadily. So based on the validation results of language criteria, Chemistry Student Worksheet in Atoms, Ions, and Molecules topic with Learning Cycle 7-E orientation can be said feasible.

The validation result of Chemistry Student Worksheet based on graphical criteria for each *worksheet* 1, 2, and 3 respectively by 79.16%, 80.56% and 80.56%. The results stated that the Chemistry Student Worksheet can be said feasible because it achieve ≥ 51% [10]. Based on score interpretation criteria in Table 2, it can be concluded the feasibility of graphical criteria for worksheet 1, 2, and 3 is very feasible.

Component of graphical criteria adapted from *Depdiknas* [3] and *BSNP* [4], there are suitability of the Chemistry Student Worksheet front and backside cover shown in contrast, clear, interesting and appropriate to the size; type, font color and also layout is appropriate; Chemistry Student Worksheet's layout presented in the form of text and illustrations (images) displayed communicative and harmoniously; suitability letters in the selection of the type, size, and color of letters; illustrations or images can help the understanding of concepts; clarity of a great prints the contents help learners learn, understand, and absorb the information submitted; selected A4 100 grams paper with a function as printed information that can delivery media and survive for at least 5 years.

Based on the validation result in graphical criteria, Chemistry Student Worksheet in atoms, ions, and molecules topic with learning cycle 7E orientation is said very feasible.

Student response to chemistry student worksheet can be knew from the results of students response questionnaire result after the limited implementation of Chemistry Student Worksheet in atoms, ions, and molecules topic to the 12 students in class VIII-1 *SMPAl-Falah* Deltasari Sidoarjo which heterogeneously selected from ability in science, seen by the science score term (4 clever students, 4 students average, and 4 students are less intelligent). Student responses result to chemistry student worksheet with learning cycle 7E orientation is shown in Table 4.

The results stated that Chemistry Student Worksheet can be said get positive responce (feasible) because it has achieve ≥ 51% [10]. Based on student response criteria that interpreted with Table 2, it can conclude the feasibility of student response criteria for worksheet 1, 2, and 3 is very feasible, marked by positive response from students in content, language, presentation, suitability with Learning Cycle 7E, and graphical criteria for Chemistry Student Worksheet. Based on the student's answer on the questions given in questionnaire, from content and language criteria the material and questions is easy to read and understand, from presentation criteria, Chemistry Student Worksheet is interesting to be studied and can motivate students to study, from the suitability with learning cycle 7-E students have opportunities to study independently and in a group.

Table 4 Student response result of Chemistry Student Worksheet with Learning Cycle 7E Orientation

No	Criteria	Assessment percentage (%)			Criteria		
		CSW 1	***CSW 2***	***CSW 3***	*CSW 1*	*CSW 2*	*CSW 3*
A.	Contents	91.67	100	87.50	Very Feasible	Very Feasible	Very Feasible
2.	Language	83.33	91.67	66.67	Very Feasible	Very Feasible	Very Feasible
3.	Presentation	80.56	97.22	80.56	Very Feasible	Very Feasible	Very Feasible
4.	Suitability with the Model *7-E Learning Cycle*	83.33	87.50	69.44	Very Feasible	Very Feasible	Feasible
5	Graphical	95.83	100	95.83	Very Feasible	Very Feasible	Very Feasible

From graphical criteria, the use of font, illustration, layout, and printing of Chemistry Student Worksheet make them easy to understand. Thus, from the result students give positive response to Chemistry Student Worksheet that has been developed.

Overall validation results of the Chemistry Student Worksheet based on criteria of content 77,38%; 78,57%; and 79,76%, presentation, 80,95%; 80,95%; and 80,95% suitability with the learning cycle 7E, 75%; 75%; and 75%; language 73,33%; 73,33%; and 73,33%; graphical, 79,16%; 80,56%; and 80,09%; and student give positive response Based on Table 2, it can be said that the Chemistry Student Worksheet in atoms, Ions, and Molecules with Learning Cycle 7-E orientation that has been developed is very feasible to be used. In the presence of good instructional materials, it is expected the learning process that teachers and students done can achieve the Graduate Competency Standards.

CONCLUSIONS

Based on result and analysis of data in this research, it can be concluded that Chemistry Student Worksheet on Atoms, Ions, and Molecules topic with Learning Cycle 7E Orientation that has been developed is feasible to be used as learning material because it achieve ≥ 51% for all aspects including: feasibility for contents criteria with a percentage of 77,38%; 78,57%; and 79,76% (very feasible); feasibility for presentation criteria with a percentage of 80,95%; 80,95%; dan 80,95% (very feasible); feasibility for suitability with the Learning Cycle 7-E criteria with a percentage of 75%; 75%; and 75% (feasible), feasibility of language criteria with a percentage of 73,33%; 73,33%; and 73,33% (feasible), feasibility of graphical criteria with persentage 79,16%; 80,56%; and 80,09%; and feasibility of student response criteria is positive (very feasible).

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