Jurnal Pendidikan Kimia 11 (2019) 37-48

e-ISSN: 2549-3116 p-ISSN: 2085-3653

Jurnal Pendidikan Kimia

http://jurnal.unimed.ac.id/2012/index.php/jpk

Development of student activities worksheet based on a comic with 4C in chemical equilibrium for class xi high school

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Received: 23 July 2019 Accepted: 28 August 2019

Abstract:

Research on the development of comic-based student activity worksheets (LKPD) with a 4C approach (Critical Thinking, Collaboration, Creativity and Communication) on chemical equilibrium material for high school is an innovation in the development of teaching materials in order to achieve the demands of 21st century learning that facilitates and inspire students to be able to think critically, communicatively, creatively, innovatively, and collaboratively. The study was designed using research and development design (R & D) with a 4-D development model. The validation sheet and user response questionnaire are research instruments designed and then analyzed and produce data in the form of assessment and suggestions by the validator team, teacher respondents and students. Feasibility aspects of content, language, presentation, graphics, and characteristics of comics with a 4C approach with an overall percentage score of 93% by the material validator. The results of the percentage of users by teachers are 95% and the percentage of students is 88% with very good criteria. Based on the data analysis, it can be concluded that student activities worksheets based on comics with a 4C approach that produced is valid and can be used on Senior High School on chemical equilibrium material.

Keywords:

Chemical equilibrium; student activities sheet based comics with 4C approach; 4-D development model

Introduction

Learning is a process that requires a systematic step to achieve a predetermined goal. The way to learn must be able to encourage students to be able to think critically and solve problems, communicative, creative, innovative, and collaborative (Kemendikbud, 2017). Chemistry is a subject in high school that requires an understanding of abstract concepts so that it requires students to learn optimally both independently and through teacher guidance (Fitri, 2016). One of the chemicals that demands this is chemical equilibrium material. Therefore, a thinking process is needed that is more than just memorizing to understand the concepts of chemical equilibrium. Chemical equilibrium material is one of the key topics in chemical education and some of its sub-topics are important material in life including reversible reactions, measurement of reaction rates and dynamic equilibrium. Many students who have difficulty understanding the topic of chemical equilibrium, especially in understanding backward reactions where there is no reaction whatsoever in the equilibrium state (Lubis, 2010).

To learn chemistry, the quality of the learning process and the achievement of learning objectives are strongly influenced by several factors, one of which is the use of teaching materials. One effort that can be done by teachers to achieve national goals is to develop teaching materials into various forms of teaching materials. Teaching materials have a variety of forms. To develop

DOI: https://doi.org/10.24114/jpkim.v11i2.14461

teaching materials, teachers are required to continuously improve their abilities. If you cannot develop varied teaching materials, the teacher will be trapped in a monotonous learning situation and tends to be boring for students (Singarimbun et al. 2015).

One of the teaching materials used by the teacher is the student activity sheet (LKPD). LKPD in general only contains material and practice questions for students. Not only that, but LKPD also does not require students to think critically as recommended in 21st-century learning. This is due to the lack of teachers' time to innovate the LKPD and to use the LKPD which is used year after year. Based on questionnaires distributed to 77 students, 88.3% said they use of LKPD in chemistry learning made learning more interesting.

Today comics are popular reading material in the world of teenagers. Graphic comics are booming reading among high school adolescents (Kurniawan et al. 2015; Minarni et al. 2019). This proves that the reading level of reading material containing writing is very lacking. Students are more interested in reading material that has a combination of writing and drawing, such as comics. Comics are an art form that uses immovable images arranged in such a way as to form the fabric of the story (Lubis, 2014). As Riandi et al. (2016) have said, the existence of images is a powerful way to help a student understand the abstract ideas presented in science learning, this can make it easier for students to understand the material with this comic media. This is the same as the LKPD provided by the teacher, they prefer the LKPD which contains interesting images rather than the LKPD which only contains writing and a few drawings. This makes them easily bored and prefers readings that are equipped with funny pictures. Lubis (2010) argues that comics are also visual communication media and are more than light and entertaining illustrated stories. As a visual communication media, comics can be applied as educational aids and can convey information effectively and efficiently. Therefore, it is necessary to develop an interesting LKPD to facilitate the learning process. The researcher was very interested in researching and developing a comic-based LKPD on chemical equilibrium material. Because currently, no one has developed the LKPD on the material. The purpose of this study was to develop comic-based LKPD with a 4C approach (Critical thinking, Collaboration, Creativity, and Communication) on chemical equilibrium material for high school as valid teaching material and to determine the user's response to LKPD used in the learning process.

Comic LKPD with a 4C approach to chemical equilibrium material contains equivalent writings and images, to meet the needs of students. This 4C approach makes students skilled in critical thinking, collaborating, creating and communicating. Comics can be used effectively by the teacher in an effort to motivate students in reading interest as Nasriyati (2019) about the effect of comic LKPD on learning motivation, it turns out that LKPD can increase students' motivation and research conducted by Saputro (2016) states that comic science media can improve learning achievement in students' critical thinking in learning. The advantages of comics according to Hidayati et al. (2016) in general in the learning process are as follows: (1) Enriching vocabulary for readers, (2) Facilitating students to capture abstract material, and (3) Can develop students' interest in reading and develop one other field of study.

Methods

The research was carried out in the Chemistry Education Study Program FKIP Universitas Riau, Bina Widya campus, 12.5 in Simpang Baru Pekanbaru. The trial was conducted at two high schools, namely in SMAN 8 Pekanbaru and MAN 2 Model Pekanbaru.

The research subjects at the development stage were three high school teachers and twenty XI class students from SMAN 8 Pekanbaru and MAN 2 Model Pekanbaru. The author chooses class XI students because class XI students have just finished the chemical equilibrium material so that their knowledge is fresher than that of class XII students. While the object of this study is comic-based LKPD with a 4C approach to chemical equilibrium material for high school.

This type of research is research and development (R & D) development with a 4-D model. According to Trianto (2012), this 4-D stage consists of four stages, namely (1) Define (2) Design; (3) Develop, and (4) Disseminate. This research was carried out only until stage 3 able to be seen in Fig 1, namely the Development stage because considering the purpose of the study was only the development of a valid LKPD and knowing the user's response.

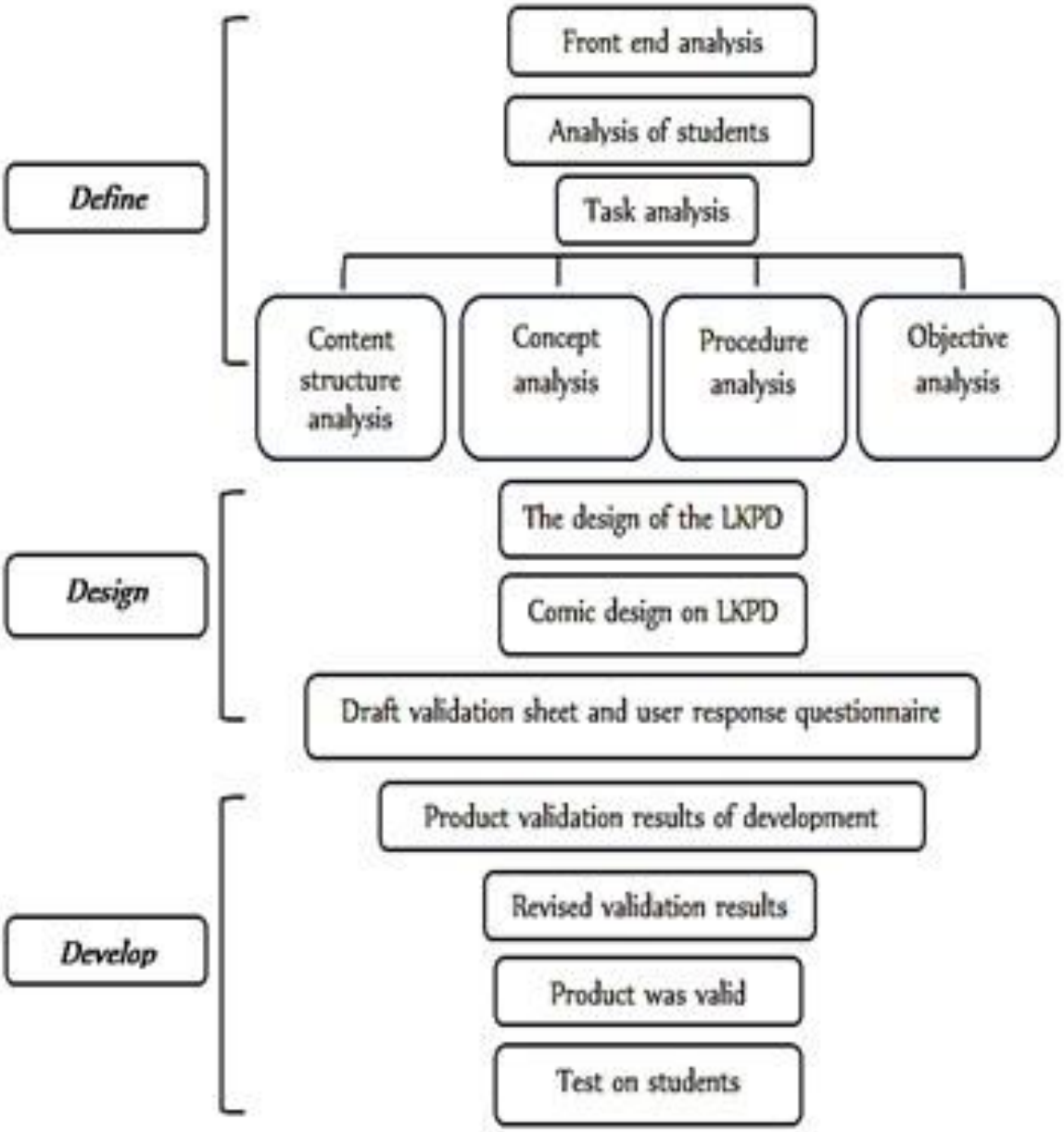

Fig 1. Flow of development of student activity sheets (Trianto, 2012).

Assessment data and suggestions related to validity are obtained through validation by the validator which includes three material expert validators, while assessment data and suggestions related to user responses are obtained through teacher response questionnaires and trials are limited to twenty high school students who have previously studied chemical equilibrium material and three high school chemistry teachers.

The data analysis technique used in this study is the analysis of the validity and analysis of user responses. Validity analysis of comic-based LKPD with the 4C approach as teaching material for high school chemistry learning on chemical equilibrium material on aspects of content feasibility, linguistic aspects, presentation aspects, and graphic aspects. Rating categories are shown in Table 1. Validation results are calculated by the average score formula, namely with the equation:

$$Percentage\ value\ (\%) = \frac{Score}{Maximum\ score} \times 100\% \quad (1)$$

The criteria for making decisions for LKPD validation can be seen in Table 2. The LKPD is used if the average rating of the validator is categorized as valid. Analysis of user responses to comic-based LKPD with a 4C approach to chemical equilibrium material for high school was conducted to chemistry teachers and students of high school. Analysis of teacher and student responses using a four Likert scale. Alternative positive statement scores in Table 3.

Table 1
Category assessment by validator (Sugiyono, 2008)

Assessment	Categories
4	Very appropriate
3	Appropriate
2	Inappropriate
1	Not appropriate

Table 2
Validity criteria (Riduwan, 2012)

Percentage	Information
80,00 – 100	Good / Valid / Worthy
60,00 – 79,99	Fairly Good / Fairly Valid / Fairly Worthy
50,00 – 59,99	Less Good / Less Valid / Less Worthy
0 – 49,99	Not Good (Replaced)

Table 3
Scores of alternative positive statements (Widoyoko, 2012)

Statement	Score
Strongly Agree	4
Agree	3
Quite Agree	2
Disagree	1

The calculation of the average alternative score of the positive statement of the teacher and students uses the calculated average equation for data that has not been grouped with the equation (Yamasari, 2010):

$$R = \frac{f}{n} \times 100\% \quad (2)$$

Information:
R = Percentage of alternative scores statement of attitudes of students/ teachers (%)
f = Total score
n = Maximum score

Data is processed by a formula, then the criteria are obtained as in Table 4.

Table 4
Criteria for user response teachers and students (Yamasari, 2010)

Percentage (%)	Criteria for response teachers and students
75,00-100	very good
50,00-74,99	good
25,00-49,99	a little good
0,00-24,99	not good

Results

Data obtained from the research results through the results of validation from the validator team consisting of three validators who are lecturers of Chemical Education. The validation process is done twice until a valid LKPD is obtained (Table 5).

Table 5
Results of the material expert team validation on aspects of content feasibility

Assessment Indicator	Total score	Percentage (%)
Suitability of comic LKPD with syllabus	11	92%
Comic LKPD in accordance with KD and Indicators	12	100%
LKPD is in accordance with the needs of students' teaching materials	11	92%
LKPD is in accordance with the substance of chemical equilibrium material	12	100%
LKPD has exercises, or the like to measure students' abilities	12	100%
LKPD can direct students to build learning concepts	12	100%
LKPD is able to increase knowledge	11	92%
LKPD has activities that allow students to be active (express opinions) in learning activities	11	92%
The comic media creates a sense of pleasure when reading it and encourages reading in a literal manner	11	92%
The benefits of material on comic media for the addition of knowledge of students' knowledge.	11	92%
The ease of comic media in understanding learning material	9	75%
Average Total Score Percentage	93%	
Eligibility criteria	Good/valid/worthy	

Based on Table 5, assessment of aspects of content eligibility according to material expert validators was rated "good/valid/worthy" with a total percentage of 93%. Data from the validation of the expert team on aspects of language feasibility are presented in Table 6.

Assessment of aspects of language feasibility according to the team of material expert validators was rated " good/valid/worthy" with a total average percentage of 93%. Data from the validation of the material expert team on the feasibility aspects of the presentation are presented in Table 7.

Assessment of the aspects of the feasibility of presentation according to the team of material experts validators was rated "good/valid/worthy" with a total percentage of an average of 96%. Data from the validation of the material expert team on aspects of graphic feasibility are presented in Table 8.

Assessment of graphic feasibility aspects according to the material expert validator team was considered "good/valid/worthy" with a total average percentage of 93%. Data from the validation

of the material expert team on the feasibility aspects of the comic characteristics with 4C are presented in Table 9.

Table 6
Results of material expert team validation on language feasibility

Assessment Indicator	Total score	Percentage (%)
The LKPD can be read clearly	12	100%
The ease of understanding comic storylines through the use of language	11	92%
The information conveyed by comics is easy to understand	11	92%
The language of comics on LKPD is easy to understand	11	92%
The use of good punctuation on comic conversations is good and right	11	92%
The language used in LKPD is effective and efficient	11	92%
Average Total Score Percentage	93%	
Eligibility criteria	Good/valid/worthy	

Table 7
Results of the material expert team validation on the feasibility of presentation

Assessment Indicator	Total score	Percentage (%)
The LKPD has clear activity objectives	11	92%
Complete format of LKPD (Title, LKPD instructions (learning instructions), learning objectives to be achieved, practice and assessment)	12	100%
The use of words in the comic dialog is right	11	92%
LKPD provides sufficient space to give students the breadth to write and describe the things that students want to convey	11	92%
The writing on the comic is clear	12	100%
LKPD can motivate students through comic pictures	12	100%
Average Total Score Percentage	96%	
Eligibility criteria	Good/valid/worthy	

Table 8
Results of the material expert team validation on feasibility of integrity

Assessment Indicator	Total score	Percentage (%)
LKPD uses good and interesting types and font sizes	11	92%
Suitability of comic images with writing	11	92%
LKPD has the layout (layout) of interest	12	100%
LKPD has good illustrations / pictures / photos that are related to the concept	11	92%
LKPD has an attractive display design	11	92%
Average Total Score Percentage	93%	
Eligibility criteria	Good/valid/worthy	

The assessment of the characteristics of comic feasibility aspects with 4C according to the material expert validator team was considered "good/valid/worthy" with a total average percentage of 92%. The percentage diagram of the score increasing the validity of various aspects by the material validator is presented in Fig 2.

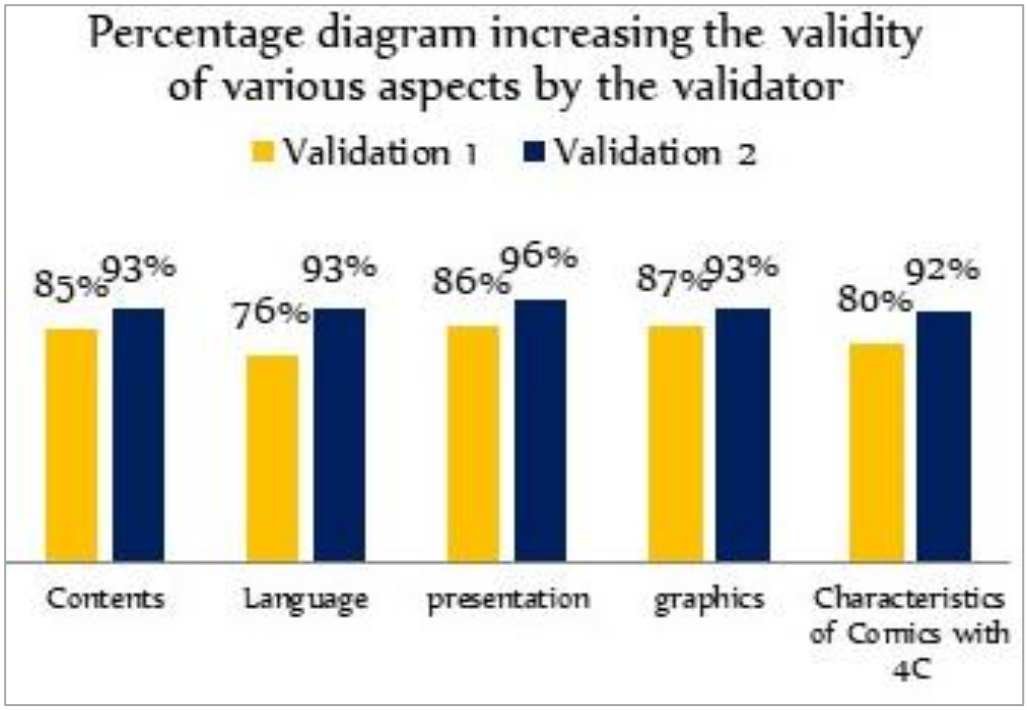

Fig 2. Percentage diagram of increasing the validity of various aspects by the validator

Table 9
Results of material expert team validation on the feasibility of characteristics of 4C comics

Assessment Indicator	Total score	Percentage (%)
The identity of the comic LKPD is clear and complete	12	100%
Images in comic stories can be seen clearly	11	92%
The comic story on the LKPD can direct students to problems with the concept of learning material	11	92%
The command sentence in the comic LKPD does not cause double meaning	10	83%
The story delivered by comics is in accordance with chemical equilibrium material	11	92%
Comic-based LKPD guides students to Critical Thinking	12	100%
Comic-based LKPD guides students to collaborate in solving problems	11	92%
Comic-based LKPD guides students to creativity in doing practice questions in the LKPD	11	92%
The LKPD encourages students to express their ideas when discussing (Communication)	11	92%
Average Total Score Percentage	92%	
Eligibility criteria	Good/valid/worthy	

The average percentage of the five validation aspects of the three material expert validators was 93%. According to Riduwan (2012) the percentage is in the range of 80%-100% so it belongs to the category of good/valid/worthy. The response of three chemistry teachers to the LKPD is presented in Table 10.

The response given by the chemistry teacher to the LKPD was "very good" with an average percentage of 95%. The data from the trial results to students are presented in Table 11.

Table 10. Assessment by chemistry teacher

Assessment indicators	Total score	Average precentage	Teacher Response Criteria
The overall appearance to the contents LKPD	11.4	95%	Very good

Table 11. Data on student responses from limited trials (20 people) to LKPD

School	Assessment indicators	Percentage Score	Average Percentage	Criteria
SMAN 8 Pekanbaru MAN 2 Model Pekanbaru	Physical appearance to the contents of the LKPD	93% 83%	88%	Very good

Data on the results of student responses can be concluded that the LKPD is included in the criteria of "very good" with an average percentage of 88%.

Discussion

The final product of the development carried out was comic-based LKPD with a 4C approach to chemical equilibrium material. LKPD designed by loading 4C components. This is supported by Zubaidah (2016) that the 4C principle of critical thinking, communication, collaboration, and creativity is the ideal learning model to meet 21st-century educational goals.

The results of the LKPD validation on the feasibility aspect of the contents fall into the category of "good/ valid/ worthy" with an average percentage of 93%. The developed LKPD shows that: (1) the LKPD is in accordance with the syllabus, (2) the LKPD is in accordance with the KD and indicators, (3) the LKPD is in accordance with the learning material requirements of the students, (4) the LKPD is in accordance with the chemical equilibrium substance and (5) LKPD can also direct students to build learning concepts. This is by one of the conditions in the preparation of the LKPD to be developed is to fulfill the didactic requirements, which are more emphasis on the process of developing social and oral communication skills (Pebrianti et al. 2016).

The results of the LKPD validation on language feasibility aspects with the category "good/ valid/ worthy" with an average percentage of 93%. The LKPD developed shows that (1) the LKPD can be read clearly, (2) the LKPD has provided easy understanding of the comic storyline, (3) the information submitted by the comic LKPD is easy to understand, (4) the comic language on LKPD is easy to understand, (5) The use of punctuation in comic conversations is good and correct, and (6) The language used in LKPD is effective and efficient. LKPD is by the construction requirements regarding the use of language, sentence structure, and vocabulary. This is by BSNP which explains that printed teaching materials must pay attention to easy language matters, concerning the flow of vocabulary, clear sentences, clear relationships between sentences, and not too long sentences.

The results of the LKPD validation on the feasibility aspects of the presentation fall into the category of "good/valid/worthy" with an average percentage of 96%. According to the LKPD it is by the structure of the LKPD according to Depdiknas (2013) which explains that the LKPD structure, in general, includes titles, learning instructions, competencies to be achieved, supporting information, assignments, and assessments. Comic LKPD can also motivate students and solve problems as revealed by Trianto (2012) that LKPD functions as a source of learning support, can be a guide for students to carry out the investigation and problem-solving activities.

The results of the LKPD validation on graphic aspects fall into the category of "good/ valid/ worthy" with an average percentage of 93%. LKPD can be seen from the use of fonts with a good and interesting size because the LKPD adapts to the type of font that is the type of Comic Sans MS with size adjusting depending on the position of the sentence. This proves that one of the technical requirements has been fulfilled, namely, the LKPD uses printed letters and does not use Latin or Roman letters. The acquisition of the score proves that LKPD in terms of graphic feasibility has met the valid category according to the BSNP.

The results of the LKPD validation on the feasibility aspects of comic characteristics with the 4C approach fall into the category of "good/ valid/ worthy" with an average percentage of 92%. Display of Comic-based LKPD with 4C approach as show in Fig 3. The developed LKPD shows that; (1) The identity of the comic LKPD is clear and complete as seen on the cover of the LKPD. This can be seen in the cover, there are Title, name of the school, class/semester, allocation of use of LKPD, and also the name of the group and the names of the students. This means that the LKPD can function properly because according to Andi Prastowo (2012) one of the functions of teaching materials is to facilitate the implementation of learning to students. (2) The picture on the comic LKPD can be seen, the statement has fulfilled the criteria of the LKPD according to BSNP. (3) Comic-based LKPD can guide students to think critically (Critical Thinking), collaborate (Collaboration), Creativity (Creativity), and discuss (Communication). This agrees with Puspitaningrum et al. (2018) that using LKPD collaborative creativity will provide the widest opportunity for students to be active in classroom learning activities and provide opportunities for students to discover and develop their concepts learned. The statement is supported by (Kemendikbud, 2017; Ashudik & Yonata, 2018) that skills must be possessed at the high school C level, namely thinking and acting skills which include creative, productive, critical, independent, collaborative, and communicative.

Fig 3. Display of comic-based LKPD with 4C approach

The recapitulation of the average score on the assessment of the five aspects of LKPD feasibility by the validator team, namely the feasibility of content, language, presentation, graphics, and comic characteristics with 4C successively having feasibility values of 93%, 93%, 96%, 93%, and 92 %. So, the overall score of the overall validation of comic LKPD with the 4C approach with chemical equilibrium material is 93%. Based on the feasibility criteria of learning devices according to Riduwan (2012), the eligibility criteria with a percentage range of 80.00–100 are categorized as "good/ valid/ worthy".

Tests on teachers are conducted on three high school chemistry teachers which include; chemistry teacher of Pekanbaru 8 High School, chemistry teacher Pekanbaru 2 Madrasah Aliyah Negeri Model 2 and chemistry teacher at Imam Syafi 2 High School IT Pekanbaru. The teacher is very interested in how to make comic LKPD. This is seen when the teacher asks for the application of the comic maker and also asks for the soft file and comic LKPD hard file because they want to apply it at school.

The overall assessment by the teacher has been very good. Another response from the three teachers is that the LKPD is very interesting if used in learning, the material presented is clear and regular because the LKPD developed contains comic picture media. Image media have the purpose to attract attention, clarify the material, illustrate facts and information. This is supported by the statement that comics are very functional in the delivery of ideas, ideas and freedom to think (Purwanto & Yuliani 2013; Listiyani & Widayati, 2012).

Comic pictures also really motivate students to learn. Comics are one of the visual media. Visual aids are instructional devices used in the classroom to encourage learning and make them easier and motivating (Saraswati, 2019).

Based on the results of the processing of trial data to students of SMAN 8 Pekanbaru, the average percentage was 93% and the average percentage of 83% was obtained from the results of the Pekanbaru MAN 2 Model students' trials. So the results of the average percentage of the two pilot schools are 88%. Referring to the user response criteria in Table 4, the average value of the total score is in the range of the percentage of 75.00% -100%. According to Yamasari (2010), this is a very good criterion, so comic LKPD based on 4C approach to chemical equilibrium material can be used by students in chemistry learning processes in chemical equilibrium material for high school.

Conclusion

Based on the results of research and discussion, it can be concluded that Comic-based LKPD with a the 4C approach to chemical equilibrium material for high school developed is "good/valid/worthy" by the material validator based on aspects of material substance with 93% percentage. In addition, the response of users is in the criteria of "very good" with an average percentage of 95% by teachers and an average percentage of 88% by students.

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