THE DEVELOPMENT OF STUDENTS WORKSHEET BASED ON MULTIPLE INTELLIGENCES FOR THE SOURCE OF MATERIALS FOR COLLOID

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Article Info

Abstract

This research was aimed to generate student worksheet based on multiple intelligences (MI) for the sub-chapter of colloid for 11th-grade students. This research used R & D model referred to Borg & Gall. This research follow ten stages of analysis, namely (1) checking of needs; (2) planning; (3) initial development of worksheet's draft; (4) preliminary field testing; (5) main product revision; (6) main field testing; (7) operational product revision; (8) operational field testing; (9) final product revision; (10) implementation and dissemination. The feasibility of student worksheet was reviewed from 5 aspects, content conformity, MI components, linguistic, physical appearance and student worksheet equipment. The average score of quality assessment result by expert validator on product quality was 3.43, with very good category. The percentage of high school chemistry teachers' response in the preliminary field testing, main field testing and operational field testing were 78.89; 83.06 and 86.85 respectively. The student of Inshafuddin High School Banda Aceh responded positively to the student worksheet based on multiple intelligences of the colloid topic with the percentage 88.33. Developed student worksheet based on MI for colloid topics was feasibly applied for learning.

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INTRODUCTION

Indonesia is placed 69th from 76 countries based on the study conducted by the Program for International Student Assessment (PISA) in 2015. The country achieved a score of 397 for reading, 386 for mathematics, and 403 for science from the average international rating of 500. Although the number improved from the survey in 2012 as in the 64th of 65 countries, this fact shows that Indonesia is still considered below average (Kertayasa, 2016). The improvement of the quality of education can be obtained from teachers' way to innovate and advance their potentials in education, specifically through a seminar, professional training, and learning material development workshop (Rezki *et al.*, 2015). A way to improve their quality is through developing the learning methods. The examples of the methods are among others discovery learning, problem-based learning, and project-based learning (Haji et al., 2015). The other aspect which can be used is through giving more engaging classroom activities which is projected from students' worksheet (LKPD). Students' worksheet is prepared to help students to gain knowledge and skills which make them actively involved in the learning process (Abdurrohim *et al.*, 2016; Kaymakci, 2012). Furthermore, Fahrucah & Sugiarto (2012) explains that worksheet helps students to be active and independent in learning specifically and steps up the quality of education generally.

Nowadays, students worksheet has become a developing tool in school. However, it is still rare for teachers to do that based on multiple intelligences (MI). MI is very appropriate to develop for knowing students' learning characteristics based on their ability, talents, and interests (Almeida *et al.*, 2010; Abdi *et al.*, 2013; Posada *et al.*, 2016). Also, Djuwita & Jamaris (2017) relate MI to holistic learning. The approach views individual completely from their intellectuality, artistic perspective, emotion, creativity, physics, and spiritual. Then, Fred & Melody (2014) state that students should be more active to grow their intellectual skills through drawing, writing, listening to music, crafting, and watching performances. The statement is supported by Karamustafaoglu (2010). He states that individuals with different learning characteristics have a different level of intelligence. Each of them can learn and succeed when they

have an organised course which considers their type of intelligence (Gani *et al.*, 2017). Students who follow MI-based learning tend to have stronger environmental awareness and learning motivation. Therefore, they can enjoy the process and become more aware of environmental issues (Gokhan, 2010). Safitri *et al.* (2013) supports the finding that MI influence students' learning behaviour and outcome in Chemistry. Besides, cooperative learning-based of MI learning can improve students' achievement (Abdulkarim & Adnan, 2012) and material processing in science (Samsudin *et al.*, 2015).

The MI-based worksheet is proven effective from many researches. Rezki *et al.* (2015) report that MI-based worksheet motivates students to learn and be independent as well as creative in employing their type of intelligence to understand the materials. According to Yalmanci & Gozum (2013), the development of this worksheet can also value the students more complexly through their cognitive, affective, and psychomotor. The worksheet also helps the teacher in guiding the students building their potentials; thereby the classroom will be more meaningful and lively (Emmiyati *et al.*, 2014; Ahvan & Pour 2016). From this background, this research is conducted to produce a proper MI-based worksheet for the learning process.

METHODS

This research took all teachers of Chemistry in Banda Aceh as the population. The researchers employed stratified random sampling for selecting the object based on the ranking of the Senior High School in Banda Aceh in their 2014/2015 rank of national examination of chemistry. The selection resulted the group of teachers from SMAN 3, SMAN 4, SMAN 5, SMAN 6, SMAN 11, SMAN 12, SMAN 13, SMAN 15, SMAN 16, SMA Laboratorium Universitas Syiah Kuala, SMA Inshafuddin, and SMA Cut Meutia Banda Aceh.

The initial step of the research is analysing the needs of the learning process in the classroom through fields observation and literature review. The next step is planning the research plan by preparing the: (1) teaser of MI-based worksheet, (2) teaser, scoring rubric, and scoring instrument to validate the worksheet by validators, (3) teaser and instruments of questionnaire for teachers and

students to response the quality of the new worksheet, (4) and identification of students' type of intelligence. Afterwards, the step is developing the draft of MI-based worksheet designed with the content which is based on nine types of intelligence.

The scoring of product quality was on the hand of three expert lecturers of Universitas Syiah Kuala and two selected teachers of Chemistry from Senior High School in Banda Aceh. Preliminary field testing occurred through the distribution of questionnaires for teachers to response the worksheet in three sample schools. After the initial revision, the researchers conducted fields trial to six teachers from different schools. Later, a more extensive test occurred objected to 18 chemistry teachers. After the completion of the final product, the next step was the dissemination of the worksheet to 15 students in SMA Inshafuddin, Banda Aceh. In this occasion, the researcher distributed the final version of MI-based worksheet for students and asked the students to fill it. After that, the researcher asked students' responses on the worksheet through a questionnaire which also covers the reflective intelligence sheet for them to know their dominant intelligence.

RESULTS AND DISCUSSION

The initial step of this research was conducted by analysing the needs of the actual learning session from fields observation and literature review. In fields observation, the study gathered information from actual learning process at school and finding the related problem to the discussion of the research. In this case, the study also analysed the availability of learning materials at school. The choice for the location came from a case study which had been happened in November 2015 at SMA Inshafuddin Banda Aceh. The study concerned the problems of Chemistry class. Several issues were identified, including limited sources of materials for students and teachers regarding colloid, the use of tedious lecturing method, and low students' participation. These problems were handled by developing an innovative worksheet based on MI to facilitate students in optimising their intellectuality. Based on Jeevitha & Vanitha (2017), planning of good students' worksheet does not only become a self-evaluation tool but also as a beginning step for the students to find the appropriate concept according

to the instruction of the worksheet. Rezki *et al.* (2015) show that MI-based worksheet can make students more motivated, confident, and creative in learning as well as be able to utilise their intelligence and dig their potentials.

The arrangement of the worksheet happened through the framing which integrates nine types of intelligence, which are visual-spatial, logics-mathematics, verbal-linguistic, intrapersonal, interpersonal, kinesthetics, musical-rhythmic, naturalist, and existentialist. The draft of students' worksheet also covers (1) cover, as the front case of the sheet which contains title, writers, and students' identity form. The cover is designed with pictures of chemistry's element as well as the symbols of nine intelligences; (2) Competence, it contains the core competence which should be achieved by the students regarding colloid; (3) "*kenali aku*" or *recognize me*, which contains the explanation of intelligence types to make students understand their dominant intellectual trait; (4) Content, covers the materials regarding colloid which includes brief concepts, task instruction, exercises, and symbols of intelligence. The column of the content is subbed with "*bertafakur*" (learning motivation), "*ayo mencoba*" (an experiment for students to try which ask them to discover the concept of the material and involve them in the discussion), "*sang penemu*" (giving students knowledge on famous inventors in chemistry), "*ayo mengasah otak*" (strategic exercise for students to solve which covers their dominant intelligence), "*info sains*" (provide students knowledge related on colloid and present them the information on how to apply that in their daily life), "*ayo diskusi*" (a case study which involves cooperation between students to solve problems), "*ayo bernyanyi*" (understanding the concept of colloid through songs lyrics), and "*pengembangan diri*" (individual creative task); (5) "*penilaian diri*" (self-reflection evaluation sheet for students to know how far they have understood the materials for teachers' evaluation) (Gani, *et al.*, 2017).

MI-based students worksheet was designed with a colourful cover. It is aimed to attract students interest that they will not be bored during the learning process. For the content of the handout, there is a blank column for students to improve their typical intelligence. Every activity in the worksheet can direct the students to

analyse and understand the concept which is served in various ways, like picture, simple experiment, crosswords, lyrical poem, and songs.
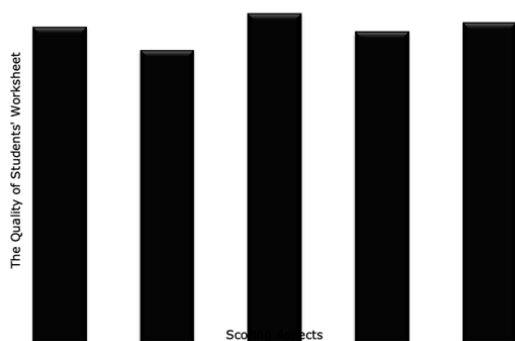
Figure 1. The score for the MI-based students' worksheet

The validity of worksheet's quality is reviewed from (1) the contents, (2) the components of MI, (3) linguistic side, (4) physical look, and (5) the part of students' worksheet. The instrument of scoring validation is adapted from BSNP based on the developed worksheet. This scoring was done by five experts which consisted of three lecturers of Universitas Syiah Kuala and two chemistry teachers. The scoring process was done by giving the initial draft and the scoring sheet of products' quality to the experts. The results of the validation can be seen in Figure 1.

Consecutively, the average score of the students' worksheet in terms of materials, MI components, linguistic side, physical look, and the completion of students' worksheet are 3.45 (very appropriate); 3.20 (appropriate); 3.60 (very appropriate); 3.40 (very appropriate); and 3.50 (very appropriate). The overall average score of the quality measurement by the validator is 3.43 which means that the product is proper for trials. The result supports the finding of Fransiska, *et al.* (2014). The average score of validation in this study is 3.91 for the material focus of elasticity and considered as very valid. Septiani *et al.* (2013) have also researched the same object on the materials of growth and development. The scores which were obtained for the study regarding appropriateness and media is 96.87 and 89.56%, which is very proper.

Besides scoring in scale, the researcher also provided commentary and suggestion column in the scoring sheet for the worksheet. The initial validation suggested some revisions on the use of

the logo in the cover, content's completion, the use of resources as well as article, and affirm the size and style of the font as well as for the writing of chemical formula.

The responses from the teacher were obtained in three steps which are preliminary field testing, main field testing, and operational field testing. The preliminary field testing was done to three chemistry teachers of SMAN 3, SMAN 11, and SMAN 13 Banda Aceh to get their suggestion to improve the new student worksheet. The gathered data were the questionnaires given to the teacher which resulted in the score of 78.89 or categorised as good. Apart from the scaling scoring, the teachers also gave comments and suggestions to the product. The suggestions were to unify the colour of the font, the removal of explanation regarding core competence to be changed with learning objectives (in line to the revised version of 2013 curriculum), the addition of a conceptual map, and the guidance to use the students' worksheet. After the revision of the product, the main field testing started.

The first preliminary field testing was conducted to chemistry teachers in SMAN 4, SMAN 5, SMAN 6, SMAN 12, and SMAN 16 Banda Aceh. The teachers' response scored 83.06% and was considered very good. The result shows that there is an improvement of average score in 4.17% after the revision and suggestions from the preliminary field testing.

The operational field testing was done to 12 chemistry teachers from public and private schools, including from SMAN 3, SMAN 4, SMAN 5, SMAN 6, SMAN 11, SMAN 12, SMAN 13, SMAN 15, SMAN 16, SMA Laboratorium Universitas Syiah Kuala, SMA Inshafuddin, and SMA Cut Meutia Banda Aceh. The data proved that the teacher responded with the average score of 86.85%, or very good. In Septiani, *et al.* (2013), the teacher gives positive responses to MI-based hand out since the learning process becomes a way for them to train the students in discovering concept and to enlight the classroom activities with joyous sequences. Thus, MI-based students worksheet can be said as very proper for the use of teaching chemistry, especially on colloid.

The responses from the students to the object of the research copes several indicators, including: the ease of using the worksheet, the

motivation after using the worksheet, variation of the learning process, the impact of the use, the appropriateness of the materials, the learning objectives in the module, experiment, the interface of the worksheet, the cover, font size, language, illustration, and the components of MI. The percentage of the results can be seen in Figure 2.

The average of students' responses were 88.33%, or very agree that the module is effective. Thus, the MI-based module got a positive response to the teaching of colloid. The result is in line to Rizal & Wasis (2012) in which the response of students' interest is 90.6%. Based on Fransiska, *et al.* (2014), the average responses of the students to the materials on elasticity in the small-group evaluation is 92.32%. The positive feedbacks show that MI-based handout is proper for being a learning material. The test of identification to self-intelligence shows that the most dominant type of intelligence and logics-mathematics (60%) and intrapersonal (53.33%), while the lowest ones are verbal-linguistics (20%) and musical-rhythmic (13.33%). In supporting that, the result of the research on the intelligence showed that the dominant type is logics-mathematics (34.78%), and the lowest score is the musical which is 1.45% (Kurniawan, 2015; Zarei & Afshar, 2014).

In comparison between students outcome and their dominant intellectual train, most of the high achiever students have strong logics-mathematics and intrapersonal intelligence. The research of Abdulkarim & Adnan (2012) shows that students with strong logics-mathematics intelligence also have a higher understanding of concepts. As in Safitri, *et al.* (2013), chemistry has four aspects of intelligence to develop, which are logics-mathematics, verbal-linguistic, intrapersonal, and interpersonal.
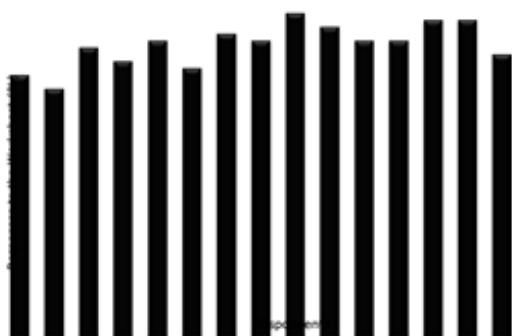

Figure 2. The Percentage of Students' Responses

CONCLUSION

Based on the results and discussion, the development of MI-based handout in colloid materials improves students' learning behaviour and outcome. The quality is proven from the average validation score of 3.43. Additionally, the result is supported by teachers' responses to the trials in the preliminary field testing, main field testing, and operational field testing, which consecutively scored 78.89; 83.06; and 86.85. Meanwhile, the students' responses were very good at the level of 88.33%.

REFERENCES

Abdi, A., Laei, S., & Ahmadyan, H. 2013. The effect of teaching strategy based on multiple intelligences on students' academic achievement in science course. *Universal Journal of Educational Research*, *1*(4), 281-284.

Abdulkarim, R. & Adnan A., J. 2012. The effect of using cooperative learning and multiple intelligences theory on physical concepts acquisition. *British Journal of Arts and Social Sciences*, 10, 137-151.

Abdurrohim, Feronika, T. & Bahriah, E.S. 2016. Pengembangan lembar kegiatan peserta didik (LKPD) berbasis inkuiri terbimbing pada materi hidrolisis garam. *Jurnal Penelitian dan Pembelajaran IPA*, *2*(2), 197-212.

Ahvan, Y. R. & Pour, H. Z. 2016. The correlation of multiple intelligences for the achievements of secondary students. *Educational Research and Reviews*, *11*(4), 141-145.

Almeida, L.S., Prieto, M.D. & Ferreira, A.I. 2010. Intelligence assessment: gardner multiple intelligence theory as an alternative. *Learning and Individual Differences*, 20, 225–230.

Djuwita, W. & Jamaris, M. 2017. Improving teachers' effectivenesss in developing 5-6 years old children's multiple intelligences based on holistic integrative instructional approach. *International Journal of Multidisciplinary and Current Research*, 5, 500-505.

Emmiyati, N., Rasyid, M.A., Rahman, M.A., Arsyad, A., & Dirawan, G.D. 2014. Multiple intelligences profile of junior secondary school students in Indonesia. *International Education Studies*, *7*(11), 103-109.

Fahrucah, E. & Sugiarto, B. 2012. Pengembangan lembar kerja peserta didik pada pembelajaran kimia SMA kelas XI pokok bahasan faktor-faktor Yang mempengaruhi laju reaksi melalui pendekatan s*caffolding*. *UNESA Journal of Chemical Education*, *1*(1), 92-96.

Fransisca, Y., Sardianto, M.S. & Muslim, M. 2014. Pengembangan lembar kerja peserta didik berbasis kecerdasan majemuk untuk pembelajaran fisika SMA Kelas X pada materi elastisitas. *Jurnal Inovasi dan Pembelajaran Fisika*, *1*(1), 1-7.

Fred, C.L & Melody, R.L. 2014. Applying multiple intelligences in the classroom: a fresh look at teaching writing. *International Journal of Scholarly Academic Intellectual Diversity*, *16*(1), 1-14.

Gani, A., Safitri, R. & Mahyana, M. 2017. Improving the visual-spatial intelligence and results of learning of junior high school students' with multiple intelligences-based students worksheet learning on lens materials. *Jurnal Pendidikan IPA Indonesian*, *6*(1), 16-22

Gokhan, B. 2010. The effects of multiple intelligences instructional strategy on the environmental awareness knowledge and environmental attitude levels of elementary students in science course. *Internasional Electronic Journal of Environmental Education*, *1*(1), 53-80.

Haji, A.G., Safriana, & Safitri, R. 2015. The use problem based learning to increase students' learning independent and to investigate students' concept understanding on rotational dynamic at students of SMA Negeri 4 Banda Aceh. *Jurnal Pendidikan IPA Indonesian*, *4*(1), 67-72.

Jeevitha, S. & Vanitha, J. 2017. A study of multiple intelligence in relating to learning style among higher secondary students. International Journal of Research Granthaalayah, *5*(6), 310-319.

Karamustafaoglu, S. 2010. Evaluating the science activities based on multiple intelligence theory. *Journal of Turkish Science Education, 7*(1), 3-12.

Kaymakci, S. 2012. A review of studies on worksheets in Turkey. *US-China Education Review A*, *1*(1), 57-64.

Kertayasa, K. 2016. *Peringkat dan capaian PISA Indonesia mengalami peningkatan*, (online), (*http://www.indonesiapisacenter.com/2016/12*), diakses 9 April 2017).

Kurniawan, D.T. 2015. Analisis kesulitan perkuliahan fisika dasar dan profil kecerdasan majemuk mahasiswa calon guru matematika tingkat I FKIP Unswagati Cirebon 2014. *Jurnal Euclid*, *1*(2), 93-104.

Posada, L.E., Lomdono, S.P. & Burgos, L.P. 2016. Multiple intelligences and curriculum implementation: progress, trendsand opportunities. *Revista de Psicodidáctica*, *22*(1), 69–83.

Rezki, D.Y., Festiyed & Asrizal. 2015. Pengaruh LKS berorientasi model kecerdasan majemuk terhadap kompetensi fisika peserta didik Kelas XI SMA Negeri 2 Padang. *Pillar of Physics Education*, 5, 129-136.

Rizal, M. & Wasis. 2012. Pengembangan LKS fisika berbasis teori kecerdasan majemuk (*multiple intelligence*) materi alat optik pada kelas VIII SMP Negeri 01 Madiun. *Jurnal Inovasi Pendidikan Fisika*, *1*(1), 120-127.

Safitri, I., Bancong, H. & Husein, H. 2013. Pengaruh pendekatan *multiple intelligences* melalui model pembelajaran langsung terhadap sikap dan hasil belajar kimia peserta didik di SMA Negeri 1 Tellu Limpoe. *Jurnal Pendidikan IPA Indonesian*, *2*(2), 156-160.

Samsudin, M.A., Haniza, N.A., Talib, C.A. & Ibrahim, H.M. 2015. The relationship between multiple intelligences with

preferred science teaching and science process skills. *Journal of Education and Learning*, *9*(1), 53-59.

Septiani, D., Ridlo, S. & Setiati, N. 2013. Pengembangan lembar kerja peserta didik berbasis *multiple intelligences* pada materi pertumbuhan dan perkembangan. *Unnes Journal of Biology Education*, *2*(3), 359-365.

Yalmanci, G. & Gozum. 2013. The effect of multiple intelligences theory based teaching on student achievement and retention of knowledge (example of the enzymes subject). *International Journal on New Trends in Education and Their Implications*, 4, 27-36.

Zarei, A. A. & Afshar, N. S. 2014. Multiple intelligences as predictors of reading comprehension. *Indonesian Journal of Applied Linguistics*, 4(1), 23-38.