The Development of Student’s Activity Sheets (SAS) Based on Multiple Intelligences and Problem-Solving Skills Using Simple Science Tools

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Abstract. The aim of this research is to produce SAS based on MI and problem-solving skills using simple science tools that are suitable to be used by elementary school students. The feasibility of SAS is evaluated based on its validity, practicality, and effectiveness. The completion Lesson Plan (LP) implementation and student’s activities are the indicators of SAS practicality. The effectiveness of SAS is measured by indicators of increased learning outcomes and problem-solving skills. The development of SAS follows the 4-D (define, design, develop, and disseminate) phase. However, this study was done until the third stage (develop). The written SAS was then validated through expert evaluation done by two experts of science, before it is tested to the target students. The try-out of SAS used one group with pre-test and post-test design. The result of this research shows that SAS is valid with “good” category. In addition, SAS is considered practical as seen from the increase of student activity at each meeting and LP implementation. Moreover, it was considered effective due to the significant difference between pre-test and post-test result of the learning outcomes and problem-solving skill test. Therefore, SAS is feasible to be used in learning.

1. Introduction
Currently and in the future, multiple intelligences are needed for everyone to face the increasingly complex challenges of life, including problem-solving skills. Everyone has a unique way to solve the problems by themselves [21]. According to Kurniawan [12], the someone’s ability to see a problem, then solve it or make something that can be useful for others is called intelligence. The definition expressed by Kurniawan is in line with Gardner's definition [6] as it is written as follows: "An intelligence as biopsychological potential to process information that is of value in a culture.” The essence of this quote is that intelligence is a measurement of how one can solve real problems in life. According to Gardner, a person is regarded to have intelligence when he or she shows a maturity and skill to solve problems and difficulties found in his or her life. To face the increasingly complex challenges of life, it does not only require a single intelligence, but it takes a lot of intelligences [4].

The importance of growing multiple intelligences is also included in the vision of the Ministry of National Education of 2025 [3] that is to result smart and competitive human beings as the outcomes. What is meant by Indonesian people who are intelligent are those having comprehensive intelligences, namely spiritual intelligence, emotional intelligence, social intelligence, kinaesthetic, and intellectual.

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To be able to achieve the vision, it is necessary to have an effort in education itself, one of which is through the learning process (Kurniawan, 2016). The learning process should be designed in such a way that each student's intelligence gets an opportunity to be developed or facilitated. The chosen learning method should also be based on multiple intelligences. In other words, the means of delivering the lesson material used by the teacher should facilitate the students in developing the nine kinds of intelligences.

According to Kurniawan [12], one of the ways to do it is that the teacher provides Student’s Activity Sheet (SAS) that can be used as a guide for them to conduct various learning activities by accommodating various intelligences in students. Gardner [5] argues that a person is intelligent when he is able to solve problems. Solving problem requires a certain skill. This problem-solving skill by McGregor [16] is very important. According to him, a good thinker should be able to adapt to situations where they find themselves. Inviting students to solve authentic problems with some possible solutions will be able to give them opportunity to develop the key cognitive skills that can support their thinking skills [16].

Researchers have observed the existence of SAS for elementary school students who facilitate nine students' intelligence. The results of this observation suggest that no such SAS has been developed through the research paradigm. That is, it has not been validated by an expert, has not been tested for its practicality, and its effectiveness as required as a learning device [17]. Kurniawan [12] states that multiple intelligence-based learning can be applied to every kind of subject, in both the exact and the social field. Based on that statement, it is necessary to develop SAS based on multiple intelligences and problem-solving skills in science learning.

2. Research Question

Research question of this study is “how is the feasibility of SAS based on multiple intelligences and problem-solving skills using simple science tools?”

3. Method

This study was a research and development (R&D) using 4-D model consisting of defining, designing, developing, and dissemination phases. However, due to the limitations, this study is only achieved at the third phase (develop). The feasibility of SAS was based on its validity, practicality, and effectiveness. The completion Lesson Plan (LP) implementation and student activities were the indicators of SAS practicality. The effectiveness of SAS was measured by the indicators obtained from the increase of learning outcomes and test of problem-solving skills. SAS trials are used to test the practicality and effectiveness implemented to 30 students at Elementary School Muhammadiyah 1 Taman Sidoarjo by using one group pre-test and post-test design. The data was obtained through some ways including validation, observation, test, and questionnaire. The data analysis techniques used were quantitative descriptive and paired sample t-test.

4. Results

4.1. Validity of Student’s Activity Sheets (SAS)

![Figure 1. Construct Validity of Both Validators](image)
Based on Figure 1, viewed from the construct validity, the development of SAS obtained expert evaluation with valid categories on 16 aspects. Therefore, construct validity of SAS based on multiple intelligences and problem-solving skills has been scientifically justified.

![Figure 2](image)

**Figure 2. Content Validity from Both Validators**

Figure 2 shows that SAS developed by the researchers has obtained valid category on all four aspects viewed from the aspect of content validity. Hence, the content validity of SAS based on multiple intelligences and problem-solving skills has been scientifically justified.

4.2. Practicality of Student Activity Sheets

4.2.1. Observation Results of Lesson Plan Implementation

![Figure 3](image)

**Figure 3. Observation Result of Lesson Plan Implementation in Three Meetings**

Based on Figure 3, four of five assessed aspects obtained “good” category from both observers in the first meeting. In the second meeting, all of five aspects obtained also “good” category, so do the last meeting with an increasing score from both observers.

4.2.2. Observation Results of Students Activities

**Table 1.** Percentage of Student Activity from Data Observation Result in Three Meetings

| No. | Observed Aspects   | Percentage of Student Activity at Meeting- |
|-----|--------------------|------------------------------------------|
|     |                    | 1  | 2  | 3  |
|     |                    | (%)| (%)| (%)|

Based on Figure 1, viewed from the construct validity, the development of SAS obtained expert evaluation with valid categories on 16 aspects. Therefore, construct validity of SAS based on multiple intelligences and problem-solving skills has been scientifically justified.
1. Paying attention to teacher explanations
2. Answering teacher’s questions
3. Conducting learning activities that include:
   a. Verbal-linguistic intelligence
   b. Logical-mathematics intelligence
   c. Visual-spatial intelligence
   d. Musical-rhythmic intelligence
   e. Body kinaesthetic intelligence
   f. Intrapersonal intelligence
   g. Interpersonal intelligence
   h. Naturalist intelligence
   i. Spiritual existence intelligence
4. Students identify problems according to the phenomenon
5. Students formulate the problems according to the phenomenon
6. Students formulate hypotheses by reading textbook first
7. Students collect and analyse the data
8. Students make conclusions based on the data
9. Students are in groups and do experiment
10. Students present the results of the discussion
11. Make a conclusion what has been learned today
12. Doing reflection

Based on Table 1, it can be concluded that there was an increase of students’ activities at each meeting though the use of Student’s Activity Sheets (SAS) based on multiple intelligences and problem-solving skills.

4.3. Effectiveness of Student Activity Sheets
The results of pre-test and post-test of cognitive product of the learning outcomes in the try-out are presented in Table 2.

| Table 2. Average Score of Cognitive Product of the Learning Outcomes and Test of Problem-Solving Skills |
|---------------------------------------------------|----------------------------------------|
| Cognitive Product of Learning Outcome | Test of Problem-Solving Skills |
| Pre-test | Post-test | Pre-test | Post-test |
| Average Score | 60.86 | 87.20 | 55.67 | 88.00 |

Viewed from cognitive product of learning outcomes, the result of t-test of paired sample t-test obtained $-t$ (count) = -22.106 < $-t$ (table) = -2.045. This means that there is a significant difference between post-test and pre-test in the process of learning by using SAS based on multiple intelligences and problem-solving skills.

Viewed from problem solving skills test, result of t-test of paired sample t-test obtained $-t$ (count) = -19.944 < $-t$ (table) = -2.045. It means that there is a significant difference between post-test and pre-test in the process of learning through the use of SAS which is developed based on multiple intelligences and problem-solving skills.

5. Discussion
Student Activity Sheets (SAS) which is developed based on multiple intelligences and problem-solving skills using simple science tools is feasible due to meet three criteria. First, overall, the validity of SAS evaluated by the expert obtained good category and can be used by adding a little improvement. It is considered appropriate because SAS was developed with good and understandable language [15]. In
addition, appropriate illustrations and font sizes can improve students' understanding of the passage in SAS [19]. Moreover, SAS aims at providing practice and motivate students to find their own knowledge [20] by using simple tools. It is supported by a research conducted by Siarni et al. [22] which states that the utilization of second hand goods as learning media can help in improving students' learning outcomes in science. Second, the criteria of practicality can be seen from the increase of students’ activities in each meeting and the LP implementation. The students’ activities and implementation of this Lesson Plan (LP) obtained good category because the students gain knowledge or understanding based on the potential respective superior intelligence they have which makes the learning process becomes more fun [7]. This is in accordance with research by Yurt and Polat [24] showing that involving multiple intelligences in learning process creates an exciting learning environment for students' sensory areas. It is supported also by researches of Abdi [1], Kilic [11], Pociask & Settles [18] and Hanafin [9]. Moreover, the problem-solving skills steps are also introduced in this SAS implementation to the students to make them more analytical in making decisions in their lives [10]. In addition, these problem-solving skills can help students improve their analytical power and can help students also to apply the power in various situations [23]. Solving such problems requires deep conceptual knowledge and understanding so that students can apply what they have learned into real life [2]. Third, the criteria of effectiveness can be seen from the significant difference between pre-test and post-test cognitive product of learning outcome and problem-solving skill test. This significant difference indicates that students are already capable of high-level thinking skills. This is in line with Lewy's [14] opinion that the indicators for measuring high-level capabilities include analyzing, evaluating, and creating. In addition, problem-solving skills on the analysis questions also considered as one aspect of High-Order Thinking Skills (HOTS) [8]. This success in achieving better score in post-test was highly related to the role of music instrument during the learning activities. It is in line with Fauzi in Kusbiantoro [13] who argues that music can make the atmosphere more relaxed, so that the brain becomes easier to receive information.

6. Conclusion
Based on the result of the try-out, the findings of research, and the discussion, it can be concluded that SAS is valid with “good” category. Moreover, SAS is considered practical as seen from the increase of students’ activities in each meeting and the LP implementation. In addition, SAS is declared as effective due to the significant difference between the pre-test and post-test of cognitive product of learning outcomes and the test of problem-solving skills. Therefore, SAS is feasible to be used in science learning.

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References
[1] Abdi A and Maryam R 2012 The Effect Multiple Intelligences-based Instruction on Students’ Creative Thinking Ability at 5th Grade in Primary School Procedia-Soc and Behav Sc. J. 47 105-108.
[2] Anderson and David 2001 Taxonomy for Learning Teaching and Assessing (New York: Logman)
[3] Depdiknas 2008 Undang-Undang SISDIKNAS (Sistem Pendidikan Nasional)UU RI no. 20 tahun 2003 (National Education System UU RI no. 20 Year 2003) (Jakarta: Depdiknas)
[4] Fritz H 2010 Attitudes and Cognitive Organizatio The Journ of Pscy whole 21 107-112
[5] Gardner H and Hatch T 1989 Multiple Intelligences Go to School: Educational Implications of the Theory of Multiple Intelligences Journal of Education. Research. 18(8) 4
[6] Gardner H 2000 Intelligence Reframed: Multiple Intelligences for the 21st Century (New York: Basic Books Inc)
[7] Gozutok 2001 The Application of Multiple Intelligence Theory to the Schools of Başkent (University College of Ayşeabla: Ankara Political Publishing)
[8] Gunawan 2003 Genius Teaching Strategy (Jakarta: Gramedia Pustaka)
[9] Hanafin 2014 Multiple Intelligences Theory, Action Research, and Teacher Professional Development: The Irish MI Project Australian J. of Teach Edu. 39 126-142
[10] Hudoyo 1988 Mengajar Belajar Matematika) (Jakarta: Departemen Pendidikan dan Kebudayaan)
[11] Kilic M S and Hakan S 2014 Primary School 5th Grade Science and Technology Lesson Book’s Investigation of Multiple Intelligences Theory Procedia-Soc. and Behv. Scienc. Journ. 174 (2015) 2577-2581
[12] Kurniawan A 2016 Learning with Multiple Intelligences at School
[13] Kusbiantoro 2010 Designing Room Lighting, Temperature and Noise Levels Thesis Surabaya Institut Teknologi Sepuluh Nopember Available on: http://digilib.its.ac.id/ITS-Undergraduate-3100010038554/9441 Accessed on Januari 2013
[14] Lewy Zulkardi & Nyimas A 2009 Development of Problem Sheet for Measuring Higher Thinking Skills Subject of Row and Class of Numbers in Class IX Acceleration of SMP Xaverius Maria Palembang Math Edu J. 3 (2) 14-28
[15] Majid A 2008 Perencanaan Pembelajaran (Bandung PT. Remaja Rosdakarya)
[16] McGregor D 2007 Developing Thinking: Developing Learning (A Guide to Thinking Skills in Education (Berkshire: Berkshire Open University Press)
[17] Nieveens & Plomp 2013 Educational Design: Introduction. From Tjeerd Plomp (eds). Educational &Training System Design: Introduction Design of Education and Training (in Dutch) Utrecht (the Netherlands) Lemma. (Netherland: Netherland Faculty of Educational Science and Technology University of Twente)
[18] Pociask A & Settles J S 2007 Increasing Student Achievement through Brain Based Studies Thesis Master in Teaching and Leadership Saint Xavier University Chicago Illinois
[19] Risky A, Sandra F, Rahmadina F, Karina M 2013 Pengaruh Pemberian Gambar pada Bacaan terhadap Pemahaman Membaca Siswa Kelas V Sekolah Dasar (Jakarta: Universitas Indonesia)
[20] Schunk 2012 Social Cognitive Theory: APA Educational Psychology Handbook Vol I: Theories, constructs, and critical issues (New York: Routledge)
[21] Serin B N, Pehlivian A, Serin O, Sahin S 2012 Relationship Between Intelligences Areas and Interpersonal Problem Solving Skills According to Multiple Intelligences Theory Intern Onl J. of Prim Edu 1 Issue 2
[22] Siami P M and Rede A 2015 Utilization of Used Goods as Learning Media to Improve Student Learning Outcomes of Grade IV SDN 07 Salume Mamuju Utara J. Create Onl Tadulako 3 (2) ISSN 2354-614X
[23] Widjajanti E 2013 Kualitas Lembar Kerja Siswa Makalah disampaikan dalam Pelatihan Penyusunan LKS Mata Pelajaran Kimia Berdasarkan Kurikulum Tingkat Satuan Pendidikan Bagi Guru SMK/MAK di Ruang Sidang Kimia FMIPA UNY
[24] Yurt and Polat 2015 The Effectiveness of Multiple Intelligences on Academic Achievement: A Meta-Analysis Journ. of Soc. Stud. Educ. Research 6 (1) 84-122