

Meta-Analysis:

Effect Size of Worksheet on Student Learning Outcomes

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Abstract—The psychomotor competency paradigm is still underdeveloped, especially in the aspects of the learning process and assessment. Student worksheets can be a tool to improve the psychomotor aspects of students. To sharpen the analysis of the usefulness of student worksheets, this research will conduct a meta-analysis of the effect size of student worksheets on student learning outcomes. Through this method, more comprehensive and balanced facts can be presented to readers. Based on the results of a study of five articles whose effect sizes were calculated, it was concluded that three studies had a moderate effect size and two studies had a strong effect size. From these results, it means that the use of student worksheets is highly recommended in learning, where student worksheets have the characteristics of training students to carry out inquiry-based learning processes and problem-solving based learning.

Keywords—meta-analysis, effect size, student worksheet, student learning outcome

I. INTRODUCTION

The 21st century demands that students not only focus on learning in the area of cognitive competence but also on the affective and psychomotor aspects. There is no meaning if students are directed to be cognitively smart but have a bad attitude and are not skilled at communicating their knowledge. Based on conditions in the field, where the psychomotor competency paradigm is still not very developed, especially in the aspects of the process and learning assessment, then, student worksheets can be one of the tools to accommodate these aspects. Student worksheets are part of learning tools that support the implementation of learning, student worksheets contain material summaries, inquiry instructions, learning that allows students to do problem-solving based activities, and has an integrated assessment [1-4]. Based on the principle, if processed in such a way, student worksheets can "inspire" students to answer and do assignments well. The statement or question is to guide students, so that students can find strategies for investigating, inquiry, solving problems, imagining, and creating independently [5].

Apart from the above opinion, in research by Kurt [6] through the use of student worksheets, it can make students discover their knowledge independently (constructivism).

Other research also suggests that student worksheets can help simplify the concept of material, so that students can develop skills in thinking quickly [7].

To sharpen the analysis of the usefulness of student worksheets, various studies have been collected on the effect of student worksheets on student learning outcomes. Through this research, a meta-analysis of the effect size of worksheet will be carried out on student learning outcomes, such as the opinion of Siswanto [8], so that research results that have similar study topics can have a significant impact, then synthesis of the results from several similar studies can be carried out, through this method, more comprehensive and balanced facts can be presented to the reader.

II. METHODS

This research uses a systematic review approach. Systematic review is a research method that summarizes the results of primary research. From the results of previous studies, a meta-analysis process will be carried out to obtain the effect of the size.

III. RESEARCH PROCEDURE

The research steps for this meta-analysis refer to Perry & Hammond [9] as follows: (1) identification of research questions (in this study, what is the effect size of student worksheet on student learning outcomes), (2) developing a meta-analysis research protocol, such as, inclusion and exclusion criteria for articles, study variables, characteristics of study objectives, year of publication, language of the articles, types of books/articles, reputation of book/journal publishers, and journal ranking [10], (3) determine the location of the research results database as a search area (in this study using Google Scholar), (4) selection of relevant research results (5) select quality previous research results, (6) data extraction from each of these studies (after selection, appears five articles and will be displayed in the data source section, table one), (7) synthesis of research results using the meta-analysis method, and (8) presenting the research results in a meta-analysis research report (as Tabel 1).

A. Data Source

TABLE I. DISTRIBUTION OF FIVE RESEARCH SUBJECT ARTICLES

No	Research Title	Content/ Learning Material	Researcher & Year	Control Class (c)			Experiment Class (t)		
				Subject (n_c)	Mean (\bar{x}_c)	Standard Deviation (S_c)	Subject (n_t)	Mean (\bar{x}_t)	Standard Deviation (S_t)
1	The Influence of Using Guided Inquiry-Based Student Worksheets on Buffer Solution Material on Learning Outcomes of Class XI Sains Subject Students of Public Senior High School 5 Padang. <i>(Pengaruh Penggunaan Lembar Kerja Siswa (LKS) Berbasis Inkuiri Terbimbing pada Materi Larutan Penyangga terhadap Hasil Belajar Siswa Kelas XI IPA SMAN 5 Padang)</i> [11].	Buffer Solution	Fikka Maypalita, Mawardi, Rahadian Zainul. 2017	31	77.40	8.36	31	83.50	11.01
2	The Influence of Guided Inquiry Oriented Student Worksheets on Science Competencies for Class VII Public Middle School 2 Bukittinggi. <i>(Pengaruh Lembar Kerja Peserta Didik Berorientasi Inkuiri Terbimbing terhadap Kompetensi IPA Kelas VII SMPN 2 Bukittinggi)</i> [12].	Psychomotor Competence	Betty Mizarwan, Ratnawulan, Gusnedi. 2015	40	71.88	8.20	38	78.92	12.6
3	The Effect of Student Worksheets Based on the Sequenced Type of Integrated Learning Model on Student Competence in Science Subjects Class VIII at Public Middle School 3 Pariaman. <i>(Pengaruh Lembar Kerja Peserta Didik (LKPD) Berbasis Model Pembelajaran Terpadu Tipe Sequenced terhadap Kompetensi Siswa pada Mata Pelajaran IPA Kelas VIII di SMP Negeri 3 Pariaman)</i> [13].	Light and Optical Equipment, and the Solar System and Life on Earth	Yogi Prima Candra, Djusmaini Djamas, Gusnedi. 2016	29	73.49	4.78	29	77.15	5.77
4	The Effect of Using Student Worksheets Reaction Rate Experiments on Guided Inquiry on Student Learning Outcomes of Class XI at Public Senior High School 4 Padang. <i>(Pengaruh Penggunaan Lembar Kerja Siswa (LKS) Eksperimen Laju Reaksi Berbasis Inkuiri Terbimbing terhadap Hasil Belajar Siswa Kelas XI MIA SMAN 4 Padang)</i> [14].	Reaction Rate	Margarita Claudya Maida, Bayharti, Andromeda. 2019	30	74.40	9.55	30	86.27	7.10
5	The Effect of Using Worksheets Based on The Problem Solving Model on The Ability to Analyze The Concept of Dynamic Fluid. <i>(Pengaruh Penggunaan Lembar Kerja Siswa (LKS) Berbasis Model Problem Solving Polya pada Konsep Fluida Dinamis terhadap Kemampuan Menganalisis Siswa)</i> [15].	Dynamic Fluid Concepts	Tofik Hidayat. 2018	30	52.03	9.55	30	64.87	9.18

B. Data Analysis Technique

The data analysis technique in this meta-analysis uses Cohen's d effect size formula [16], after the effect size is found, it is interpreted qualitatively using the effect size criteria [17]. Based on these results, an analysis of the effect size on student worksheets was carried out on student learning outcomes.

IV. RESULTS AND DISCUSSION

A. Effect Size of Student Worksheet on Buffer Solution Learning Material

TABLE II. STUDENT WORKSHEET EFFECT SIZE ON BUFFER SOLUTION LEARNING MATERIAL [11]

Cohen's d Effect Size	Criteria
0.63	Moderate Effect

Based on the table 2, the results of the meta-analysis of the student worksheet effect size on the buffer solution learning material for class XI students, it was found that the student worksheet had a moderate effect. This can be observed from

the results of calculations using Cohen's d effect size formula, the value is 0.63. The comparison of the results of the effect size against the criteria is said to be moderate, if it gives results from 0.51 to 1.00. From these results, the effect of the student worksheet cannot be ignored.

B. Effect Size of Student Worksheet on Psychomotor Competence

TABLE III. EFFECT SIZE OF STUDENT WORKSHEET ON PSYCHOMOTOR COMPETENCIES [1]

Cohen's d Effect Size	Criteria
0.67	Moderate Effect

Based on the table 3, the results of the meta-analysis of the student worksheet effect size on the psychomotor competency of grade VII students, it was found that the student worksheet had a moderate effect. This can be observed from the results of calculations using Cohen's d effect size formula, the value is 0.67. The comparison of the results of the effect size against the criteria is said to be moderate, if it gives results from 0.51 to 1.00. From these results, the effect of student worksheet cannot be ignored.

C. Effect Size of Student Worksheet on Learning Material of Light and Optical Devices, and the Solar System and Life on Earth

TABLE IV. EFFECT SIZE OF STUDENT WORKSHEET ON LEARNING MATERIAL OF LIGHT AND OPTICAL DEVICES, AND THE SOLAR SYSTEM AND LIFE ON EARTH [13]

Cohen's d Effect Size	Criteria
0.70	Moderate Effect

Based on the table 4, the results of the meta-analysis of the student worksheet effect size on the learning material of light and optical devices, and the solar system and life on earth for seventh-grade students, found that the student worksheet had a moderate effect. This can be observed from the results of calculations using Cohen's d effect size formula, the value is 0.70. The comparison of the results of the effect size against the criteria is said to be moderate, if it gives results from 0.51 to 1.00. From these results, the effect of student worksheet cannot be ignored.

D. Effect Size of Student Worksheet on Learning Material of Reaction Rate

TABLE V. EFFECT SIZE OF STUDENT WORKSHEET ON LEARNING MATERIAL OF REACTION RATE [14]

Cohen's d Effect Size	Criteria
1.43	Strong Effect

Based on the table 5, the results of the meta-analysis of the student worksheet effect size on the learning material of reaction rate in class XI students, it was found that student

worksheet had a strong effect. This can be observed from the results of calculations using Cohen's d effect size formula, the value is 1.43. The comparison of the effect size results against the criteria is said to be strong, if it gives results >1.00. From these results, the effect of student worksheet is very worthy of attention.

E. Effect Size of Student Worksheet on Learning Material of Dynamic Fluid Concepts

TABLE VI. EFFECT SIZE OF STUDENT WORKSHEET ON LEARNING MATERIAL OF DYNAMIC FLUID CONCEPTS [15]

Cohen's d Effect Size	Criteria
1.39	Strong Effect

Based on the table 6, the results of the meta-analysis of the student worksheet effect size on the learning material of dynamic fluid concepts in class XI students, it was found that student worksheet had a strong effect. This can be observed from the results of calculations using Cohen's d effect size formula, the value is 1.39. The comparison of the effect size results against the criteria is said to be strong, if it gives results > 1.00. From these results, the effect of student worksheet is very worthy of attention.

The results of the analysis of the five articles above show that the student worksheet has a positive influence on student learning outcomes. Three of them have a moderate effect size and two of them have a strong effect size.

Based on data according to Maypalita, Mawardi, & Zainul [11], the use of student worksheets on the buffer solution learning material appears to have a moderate effect size, in this study it is revealed that student worksheets allow students to be more active and excited. Material concepts become more directed to students.

Based on the concept, student worksheets are sheets containing material summaries, implementation instructions that are inquiry and problem solving through an activity that performs and has an assessment in it [1-4]. In line with the opinion aside, based on research by Mawardi, Zainul, & Aumi [18], the use of student worksheets allows students to do inquiry-based learning, where according to inquiry activities will familiarize students with learning and solving problems, think critically, and be responsible in understanding independently.

In addition, the student worksheet contains pictures, graphs, discussion sheets, data tables, and various other activities that are systematically arranged [19]. Based on research by Maypalita, Mawardi, & Zainul [11], this can make students more guided in answering or working on questions, assignments or problems that must be solved. Through the systematic component of student worksheet, it can maximize all students' abilities to think critically, logically, and analytically, and build their understanding of the concepts being studied.

Other studies that show a moderate effect size are research by Mizarwan, Ratnawulan, & Gusnedi [12] and research by Candra, Djamas, & Gusnedi [13]. According to this research, the characteristics of the student worksheet are in the form of inquiry work steps, therefore, it requires directed work steps. These steps help students learn actively, creative, and innovative in learning, investigate a problem to solve, and find their concept through the process of investigation [12].

The use of student worksheet in Candra, Djamas, & Gusnedi's [12] research, generally concludes that it does not yet have a significant effect (the t-test in this study is not significant, due to the lack of supporting infrastructure facilities), but in this study it states that, through student worksheet, students can be motivated to actively discuss and gather information. Discussion activities are very facilitated because students clearly know the object of the task/active in learning, so that there is no floating direction of student learning [12].

The next data that shows the effect size of student worksheet on student learning outcomes is the research of Maida, Bayharti, & Andromeda [14] and Hidayat [15]. From the two studies, the effect size of student worksheet entered the criteria had a strong effect. From the two studies, various rationalizations of the excess influence of student worksheet were presented. In general, this rationalization is in line with the opinion of Prastowo [2] that student worksheet can (1) activate students in the learning process, (2) help students develop concepts, (3) train students in finding and developing process skills, (4) as a guide for educators and students in carrying out the learning process, (5) helping students obtain notes about the material studied through learning activities, and (6) helping students to add information about the concepts learned through systematic learning activities.

V. CONCLUSION

Based on the results of a study of five articles on student worksheet which have calculated the effect size, it can be concluded that three studies have a moderate effect size and two studies have a strong effect size. From these results provide information that the use of student worksheet is highly recommended in learning, where student worksheet has the advantage of inquiry-based learning and problem-solving based learning. Through inquiry activities will train students to learn and solve problems, think critically, be responsible for understanding independently. Through problem-solving, students will practice critical, logical, and analytical thinking and build their understanding of the concepts being studied.

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REFERENCES

- [1] K.A. Aka and B.A. Mukmin, "Worksheet Performance Evaluation Oriented Scientific Approach," *Universal Journal of Educational Research*, vol. 8, no. 6, pp. 2270-2275, 2020.
- [2] A. Prastowo, *Panduan Kreatif Membuat Bahan Ajar Inovatif*. Yogyakarta: Diva Press, 2014.
- [3] Trianto, *Mendesain Model Pembelajaran Inovatif-Progresif Konsep Landasan dan Implementasinya Pada Kurikulum Tingkat Satuan Pendidikan (KTSP)*, Jakarta : Kencana Prenada Media, 2012.
- [4] Widyantini, *Penyusunan Lembar Kegiatan Siswa sebagai Bahan Ajar*, Yogyakarta: Pusat Pengembangan dan Pemberdayaan Pendidik dan Tenaga Kependidikan, 2013.
- [5] A. Majid, *Perencanaan Pembelajaran: Mengembangkan Standar Kompetensi Guru*, Bandung: PT. Remaja Rosdakarya, 2015.
- [6] Ş Kurt, *Fizik öğretiminde bütünlleştirici öğrenme kuramına uygun çalışma yapıklarının geliştirilmesi*. Fen Bilimleri Enstitüsü, Yüksek lisans tezi, KT Ü., Trabzon, 2002.
- [7] İ. Çakır and I. Cerrah, Ö. *Fen bilgisi Öğretmenlerine Çalışma Yaprağı Hazırlama ve kullanma Becerisi Kazandırmaya Yönelik Uygulama, Ulusal Fen Bilimleri ve Matematik Eğitimi Kongresi tebliği*, Gazi Üniversitesi, Gazi Eğitim Fakültesi, Ankara, 2004.
- [8] S. Siswanto, "Systematic review sebagai metode penelitian untuk mensintesis hasil-hasil penelitian (sebuah pengantar)," *Buletin Penelitian Sistem Kesehatan*, vol. 13, no. 4, pp. 21312, 2010.
- [9] A. Perry and N. Hammond, "Systematic Review: The Experience of a PhD Student," *Psychology Learning and Teaching* vol. 2, no. 1, pp. 32–35, 2020.
- [10] H. Snyder, "Literature review as a research methodology: An overview and guidelines," *Journal of Business Research*, vol. 104, pp. 333-339, 2019.
- [11] F. Maypalita, Mawardi, and R. Zainul, *Pengaruh Penggunaan Lembar Kerja Siswa (LKS) Berbasis Inkuiri Terbimbing Pada Materi Larutan Penyangga Terhadap Hasil Belajar Siswa Kelas XI IPA SMAN 5 Padang*, 2018.
- [12] B. Mizarwan, Ratnawulan, and Gusnedi, "Pengaruh Lembar Kerja Peserta Didik Berorientasi Inkuiri Terbimbing Terhadap Kompetensi Ipa Kelas VII SMPN 2 Bukittinggi," *Pillar Of Physics Education*, vol. 6, no. 2, 2015.
- [13] Y.P. Candra, D. Djamas, and Gusnedi, "Pengaruh Lembar Kerja Peserta Didik (STUDENT WORKSHEET) Berbasis Model Pembelajaran Terpadu Tipe Sequenced terhadap Kompetensi Siswa pada Mata Pelajaran IPA Kelas VIII di SMP Negeri 3 Pariaman," *Pillar of Physics Education*, vol. 8, no. 1, 2015.
- [14] M.C. Maida, Bayharti, and Andromeda, "Pengaruh Penggunaan Lembar Kerja Siswa (LKS) Eksperimen Laju Reaksi Berbasis Inkuiri Terbimbing Terhadap Hasil Belajar Siswa Kelas XI MIA SMAN 4 Padang," *Jurnal Eksakta Pendidikan (JEP)*, vol. 3, no. 1, pp. 75-81, 2019.
- [15] T. Hidayat, "Pengaruh Penggunaan Lembar Kerja Siswa (LKS) Berbasis Model Problem Solving Polya pada Konsep Fluida Dinamis terhadap Kemampuan Menganalisis Siswa," *Jurnal Gemaedu*, vol. 3, no. 2, pp. 111-121, 2018.
- [16] J. Cohen, *Statistical Power Analysis for the Behavioral Sciences* (Second edition). NY: Department of Psychology New York University, 1988.
- [17] L. Cohen, L. Manion, and K. Morrison, *Research Methods in Education* (Sixth edition). Taylor & Francis e-Library, 2007.
- [18] Mawardi, R. Zainul, and V. Aumi, "Pengembangan Bahan Ajar untuk Aktivitas Kelas dan Laboratorium Berbasis Inkuiri Terbimbing pada Materi Laju Reaksi sebagai Pendukung keterlaksanaan Pembelajaran Sesuai Tuntutan Kurikulum 2013," *Prosiding Konvensi Nasional Pendidikan Indonesia (KONASPI) VIII*, pp. 522-527, 2016.
- [19] D.M. Hanson, *Designing Process-Oriented Guided-Inquiry Activities*. In *Faculty Guidedbook: A Comprehensive Tool For Improving Faculty Performance*, ed. S. W. Beyerlein and D. K. Apple. Lisle, IL: Pacific Crest, 2005.