DEVELOPING A COLLABORATIVE PROBLEM-SOLVING ASSESSMENT TOOL ON THE CLUSTER TOPIC OF ORGAN SYSTEM

RESEARCH PAPER

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Arranged by:

Reinald Muhammad Naufal

1504858

INTERNATIONAL PROGRAM ON SCIENCE EDUCATION

FACULTY OF MATHEMATICS AND SCIENCE EDUCATION

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Oleh:

Reinald Muhammad Naufal

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APPROVAL SHEET

DEVELOPING A COLLABORATIVE PROBLEM-SOLVING ASSESSMENT TOOL ON THE CLUSTER TOPIC OF ORGAN SYSTEM

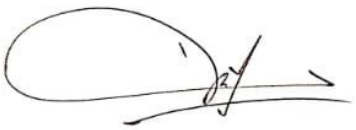
By:
Reinald Muhammad Naufal
1504858

Approved by:

Supervisor I

Prof. Dr. Hj. Nuryani Y. Rustaman, M.Pd.
NIP. 195012311979032029

Supervisor II



Lala Septem Riza, M.T., Ph.D.
NIP. 19780926 2008121001

Perceived by,

Head of International Program on Science Education Study Program

Dr. Eka Cahya Prima, S.Pd., M.T.
NIP. 199006262014041001

DECLARATION

I do hereby declare that every aspect was written in this research paper entitled "Developing a Collaborative Problem-Solving Assessment Tool on the Cluster Topic of Organ System" genuinely results of my original idea, effort, and works. The theories, findings of experts, opinions, and others contained in this paper have been quoted or referenced based on scientific code from UPI and in accordance with scientific ethics that applies in scholarly society. This declaration is created truthfully and consciously. When an infringement towards scientific ethics subsequently is found or if there is a claim of any others towards the authenticity of this research paper, hence I am willing to responsible and accept academicals sanctions correspond to the rules.

Bandung, August 2019

Declarant,

Reinald Muhammad Naufal

NIM. 1504858

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Reinald Muhammad Naufal

International Program on Science Education

Universitas Pendidikan Indonesia

ABSTRACT

In Programme for International Student Assessment (PISA) 2015, an assessment tool was developed in order to measure Collaborative Problem-Solving proficiency, but the assessment tool is aimed to only gather data in a large scale and is difficult to be used in classroom situations. This research aims to develop an assessment tool that teachers can use to measure the CPS skills of 8th graders students in the classroom, using topics of organ system as the theme. This study uses developmental research method, with prototyping development model. The development went through (1) Preparation stage, (2) Development stage, (3) Testing stage, and (4) Final stage. The final products of this research are CPS assessment tool and CPS assessment rubric. The expert judgment of logical thinking assessment deemed the instrument to be valid under "very good" category, with three items does not reflect the competencies. The expert judgment of ICT on science teaching media determines that the application is readable and falls under "very good" category, with the application needs to include a more comprehensive tutorial. After testing the assessment tool through 19 students of 8th grade in Labschool UPI, the readability of the application falls under the "good" category, with students demands the assessment tool to add more pictures as to increase the interests of students using it. In the final stage, after all data of validity and readability were analyzed, it was determined that the CPS assessment tool developed in this research can measure the CPS skill of 8th graders student.

Keywords: *Collaborative problem-solving, PISA, Computer-assisted Assessment tool, Prototyping development model, Organ system.*

MENGEMBANGKAN ALAT PENILAIAN *COLLABORATIVE PROBLEM-SOLVING* PADA RUMPUN TOPIK SISTEM ORGAN

Reinald Muhammad Naufal

International Program on Science Education

Universitas Pendidikan Indonesia

ABSTRAK

Dalam *Programme for International Student Assessment* (PISA) 2015, sebuah alat ukur dikembangkan untuk mengukur kemampuan *Collaborative Problem-Solving (CPS)* siswa, tetapi alat ukur tersebut hanya bisa digunakan untuk mengambil data dalam jumlah besar dan sulit digunakan dalam kelas oleh guru. Studi ini bertujuan untuk mengembangkan alat ukur yang bisa digunakan oleh guru untuk mengukur kemampuan CPS siswa kelas 8 dengan menggunakan rumpun topik sistem organ sebagai tema alat ukurnya. Studi ini menggunakan metode pengembangan, dengan model pengembangan *prototyping*. Proses pengembangan alat ukur ini melalui tahapan: (1) Konsepsi, (2) Pengembangan, (3) Percobaan, dan (4) Finalisasi. Produk akhir dari studi ini berupa alat ukur kemampuan CPS, serta rubrik pengukuran CPS. Penilai ahli dari asesmen berpikir logis menyatakan bahwa alat ukur CPS valid pada kategori "sangat baik", dengan tiga item tes yang tidak sesuai dengan kompetensi. Penilai ahli dari teknologi informasi dan komunikasi pada media pembelajaran sains menyatakan bahwa alat ukur CPS terbaca dan ada pada kategori "sangat baik", dengan aplikasi yang tidak memiliki bimbingan yang komprehensif. Setelah alat ukur dicobakan pada 19 siswa kelas 8 di Labschool UPI, dinyatakan bahwa alat ukur CPS memiliki keterbacaan pada kategori "baik", dengan siswa yang meminta untuk aplikasi memiliki gambar dan animasi agar menjadi lebih menarik. Dalam tahap finalisasi, data validitas dan keterbacaan alat ukur dianalisa, dan dinyatakan bahwa alat ukur kemampuan CPS yang dikembangkan dalam studi ini dapat mengukur kemampuan CPS siswa kelas 8 dengan menggunakan rumpun topik sistem organ sebagai temanya.

Kata kunci: *Collaborative problem-solving,* PISA, Alat ukur berbasis komputer Model pengembangan *Prototyping,* Sistem Organ

PREFACE

All praise belongs to Allah SWT because of His Mercy and Grace, the author could finish the research paper entitled "Developing a Collaborative Problem-Solving Assessment Tool on the Cluster Topic of Organ System". *Salawat* and *Salaam* might be sent upon the prophet Muhammad, the last of His Messengers and prophet, his family, companions, and all those who follow his steps till the end of the time.

The research had been conducted to develop the collaborative problem-solving assessment tool on the cluster topic of organ system. This research paper is the requirement to fulfill the Bachelor Degree of International Program on Science Education.

The perfection belongs to Allah. The author realizes that there are many limitations that need to be fixed and improved. Thus, suggestions, comments, and recommendations are openly welcomed for the better quality of mobile learning application in the future. Hopefully, this research might bring benefits for science education, technical aspect, and better learning and teaching implementation.

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Reinald Muhammad Naufal

NIM. 1504858

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References

Ananiadou, K. & Claro, M. (2009), 21st Century Skills and Competences for New Millennium Learners in OECD Countries, *OECD Education Working Papers*, No. 41, OECD Publishing.http://dx.doi.org/-10.1787/218525261154

Arikunto, S. (2010). Prosedur Penelitian Suatu Pendekatan Praktik. Jakarta: Rineka Cipta

Autor, D.H., F. Levy, & R.J. Murnane (2003). The skill content of recent technological change: An empirical exploration, *The Quarterly Journal of Economics*, Vol. 118/4, pp. 1279-1333, https://doi.org/10.1162/003355303322552801.

Balta, N. & Awedh, M.H. (2017). The Effect of Student Collaboration in Solving Physics Problems Using an Online Interactive Response System. *European Journal of Educational Research*, 6(3), 385-394. https://dx.doi.org/-10.12973/eu-jer.6.3.385

Barnes, L. B., Barnes, L. B., Barnes, L. B., Christensen, C. R., Hansen, A. J., & Hansen, T. L. (1994). Teaching and the case method: Text, cases, and readings. Harvard: Harvard Business Press.

Bratley, P., Fox, B. L., & Schrage, L. E. (2011). A guide to simulation. Springer Science & Business Media. https://doi.org/10.1007/978-1-4419-8724-2

Casner-Lotto, J. & Barrington, L. (2006). Are They Really Ready to Work? Employers' Perspectives on the Basic Knowledge and Applied Skills of New Entrants to the 21st Century US Workforce: ERIC

Chener T. S., Lee C., Fegely A., & Santaniello L. A. (2016). A Detailed Rubric for Assessing the Quality of Teacher Resource Apps. *Journal of Information Technology Education: Innovations in Practice*. 15. 117-143. 10.28945/3527.

Deming, D. J. (2017). The Growing Importance of Social Skills in the Labor Market. *The Quarterly Journal of Economics*, 132(4), 1593–1640. doi:10.1093/qje/qjx022

Department for Education and the Welsh Office (DFE/WO) (1995), Design and Technology in the National Curriculum, London: HMSO.

Freeman, L. & Greenacre, L. (2010). An examination of socially destructive behaviors in group work. *Journal of Marketing Education*, 33, 5–17

Fu, Q. K. & Hwang, G. J. (2018). Trends in mobile technology-supported collaborative learning: A systematic review of journal publications from 2007 to 2016. *Computers & Education*, 119, 129-143. doi:10.1016/j.compedu.2018.01.004

Gómez-Sánchez, Eduardo & Bote-Lorenzo, Miguel & Jorrín Abellán, Iván Manuel & Vega-gorgojo, Guillermo & Asensio-Pérez, Juan & Dimitriadis, Yannis. (2009). Conceptual framework for design, technological support and evaluation of collaborative learning. *International Journal of Engineering Education*. 25. 557-568.

Goodsell, A. S. (1992). Collaborative learning: A sourcebook for higher education. Pennsylvania: National Center on Postsecondary Teaching, Learning, and Assessment, University Park

Graesser, A. C., Foltz, P. W., Rosen, Y., Shaffer, D. W., Forsyth, C., & Germany, M. L. (2018). Challenges of assessing collaborative problem solving. *Assessment and teaching of 21st century skills* (pp. 75-91). Springer, Cham.

Gravemeijer, K. (1998). Developmental Research as a Research Method. New ICMI Studies Series, 277–295.doi:10.1007/978-94-011-5470-3_18

Greiff, S., Herborn, K., & Stadler, M. (2018). Collaborative problem-solving assessment in PISA 2015. Can computer agents replace humans? In F. Zehner & L. Khorramdel (Eds.), *Collaborative problem solving. Standardized assessment at the large scale*.

Hodgson, V., McConnell, D., & Dirckinck-Holmfeld, L. (2012). The theory, practice and pedagogy of networked learning. *In Exploring the theory, pedagogy and practice of networked learning* (pp. 291-305): Springer.

Hwang, G. J., Shi, Y. R., & Chu, H. C. (2011). A concept map approach to developing collaborative Mindtools for context-aware ubiquitous learning. *British Journal of Educational Technology*, 42(5), 778-789

Janssen, J., Erkens, G., Kanselaar, G., & Jaspers, J. (2007). Visualization of participation: Does it contribute to successful computer-supported collaborative learning? *Computers & Education*, 49, 1037–1065

Johnson, D. W., & Johnson, R. T. (1999). Making cooperative learning work. *Theory into practice*, 38(2), 67-73.

Johnson, D. W., Johnson, R. T., & Smith, K. (2007). The state of cooperative learning in postsecondary and professional settings. *Educational Psychology* Review, 19(1), 15-29.

Kementerian Pendidikan Dan Kebudayaan (2017). Model Silabus Mata Pelajaran Sekolah Menengah Pertama/Madrasah Tsanawiyah: Mata Pelajaran Ilmu Pengetahuan Alam (SMP/MTs). 1-78.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: a review of the research. *Computers in human behavior*, 19(3), 335-353.

Lave, J. (1988), Cognition in Practice: Mind, Mathematics and Culture in Everyday Life, Cambridge: Cambridge University Press.

Levy, F. & Murnane, R. J. (2005). The new division of labor: How computers are creating the next job market. Princeton: Princeton University Press.

Li, M. & Campbell, J. (2008). Asian students' perceptions of group work and group assignments in a New Zealand tertiary institution. *Intercultural Education*, 19, 203–216.

Miller, D. I. (1981). Experience in Decision Making for Students of Industrial Psychology. Washington, DC: Univ. Press of America.

Miyake, N. (1986). Constructive interaction and the iterative process of understanding. *Cognitive Science*, 10, 151–177.

Murnane, R.J., J.B. Willett, & F. Levy (1995), The growing importance of cognitive skills in wage determination, *The Review of Economics and Statistics*, Vol. 77/2, pp. 251-266, http://doi.org/10.2307/2109863.

Norris, C, & Poirot, J. L. (1990). Problem solving and critical thinking for computer science educators [Monograph]. Eugene, OR: International Society for Technology in Education

OECD (Organization for Economic Cooperation and Development) (2013a), OECD Skills Outlook 2013: First Results from the Survey of Adult Skills, OECD Publishing. http://dx.doi.org/10.1787/9789264204256-en

OECD (Organization for Economic Cooperation and Development) (2014). PISA 2012 results: Creative problem solving: Students' skills in tackling real-life problems (Volume V): OECD, Paris, France.

OECD (Organization for Economic Cooperation and Development) (1999). Measuring student knowledge and skills: A new framework for assessment Paris: OECD.

OECD (Organization for Economic Cooperation and Development) (2017). PISA 2015 Results: Collaborative Problem-Solving (Volume V).

Panitz, T. (1999). Collaborative versus Cooperative Learning: A Comparison of the Two Concepts Which Will Help Us Understand the Underlying Nature of Interactive Learning. *Active Learning*, 13.

Pauli, R., Mohiyeddini, C., Bray, D., Michie, F., & Street, B. (2008). Individual differences in negative group work experiences in collaborative student learning. *Educational Psychology*, 28, 47–58.

Riduwan. (2010). Metode dan Teknik Menyusun Proposal Penelitian. Bandung: Alfabeta.

Ritter, S., Murray, R. C., & Hausmann, R. G. (2018). Educational Software Design: Education, Engagement, and Productivity Concerns. *In End-User Considerations in Educational Technology Design* (pp. 35-51). IGI Global.

Rogoff, B. (1990). Apprenticeship in thinking: Cognitive development in social context. Oxford: Oxford university press.

Roschelle, J. (1992). Learning by collaborating: Convergent conceptual change. *Journal of the Learning Sciences*, 2, 235–276.

Rosen, Y., & Rimor, R. (2009). Using a collaborative database to enhance students' knowledge construction. *Interdisciplinary Journal of E-Learning and Learning Objects*, 5(1), 187-195.

Slavin, R. E. (1996). Research on cooperative learning and achievement: What we know, what we need to know. *Contemporary educational psychology*, 21(1), 43-69.

Slavin, R. E. (2014). Cooperative Learning and Academic Achievement: Why Does Groupwork Work? *Anales de Psicología/Annals of Psychology*, 30(3), 785-791.

Vygotsky, L. (1978). Mind in society: the development of higher psychological process. Cambridge, MA: Harvard University Press.

Waters, A. E., Studer, C., & Baraniuk, R. G. (2014). Collaboration-type identification in educational datasets. *Journal of Educational Data Mining*, 6(1), 28-5