22 (2), 2021, 305-311

Jurnal Pendidikan MIPA

e-ISSN: 2550-1313 | p-ISSN: 2087-9849

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Development of The Performance Assessment Based on Cassava Peel Waste Project to Measure Creative Thinking Skills of Junior High School Students

Chansyanah Diawati[1,*], Noor Fadiawati[1], M. Mahfudz Fauzi Syamsuri[2]

[1]Department of Chemical Education, Universitas Lampung, Indonesia
[2] Department of Chemistry, Universitas Islam Negeri Raden Fatah Palembang, Indonesia

Abstract: This study aims to develop a performance assessment based on the cassava peel waste processing project. This research uses methods of research and development 4D models which are only carried out until the stage of develop. At the define stage, a literature study and a preliminary study are carried out. At the design stage, planning and preparation of the initial draft are carried out in the form of performance assessments. In the develop stage, two science education experts validated the suitability of the content and construction of the performance assessment instrument to Torrance's framework of indicators creative thinking skills. The product of the validation results was then responded to the suitability of the content and construction aspects of the indicators of creative thinking skills by three science teachers. The results of expert validation and teacher responses indicate that the performance assessment instrument product is very suitable to be used to assess student performance in integrated science learning based on cassava peel waste treatment projects.

Keywords: performance assessment, cassava peel waste project, creative thinking skills.

Abstrak: *Penelitian ini bertujuan untuk mengembangkan instrument asesmen kinerja berbasis proyek pengolahan limbah kulit singkong. Penelitian ini menggunakan metode penelitian dan pengembangan model 4D yang hanya dilakukan sampai tahap develop. Pada tahap define dilakukan studi literatur dan studi pendahuluan. Pada tahap desain, dilakukan perencanaan dan penyusunan draft awal dalam bentuk asesmen kinerja. Pada tahap develop, dua orang ahli Pendidikan IPA memvalidasi kesesuaian isi dan konstruksi instrumen asesmen kinerja terhadap indikator keterampilan berpikir kreatif Frame Work Torrance. Produk hasil validasi selanjutnya direspon aspek kesesuaian isi dan konstruksinya terhadap indikator keterampilan berpikir kreatif oleh tiga orang guru IPA. Hasil validasi ahli dan tanggapan guru menunjukkan bahwa produk instrumen asesmen kinerja sangat layak digunakan untuk menilai kinerja siswa dalam pembelajaran IPA terpadu berbasis proyek pengolahan limbah kulit singkong.*

Kata kunci: *asesmen kinerja, proyek limbah kulit singkong, keterampilan berpikir kreatif.*

Chansyanah Diawati et al.
Email: chansyanah.diawati@fkip.unila.ac.id

DOI: http://dx.doi.org/10.23960/jpmipa/v22i2.pp305-311
Received: 24 November 2021
Accepted: 28 December 2021

▪ INTRODUCTION

The substance of science subject in Junior High School is integrated science according to Minister of Education Regulation (*Permendiknas)* No. 23 of 2006 concerning curriculum structure (Listyawati, 2012; Nisak, 2013). In the Curriculum 2013 Development guidelines, science learning in junior high school was developed as an integrative science subject (Ni'mah, Saptorini, & Pamelasari, 2013; Susilowati, 2013). The National Science Teachers Association (NSTA) and the Minister of Education Regulation Republik Indonesia No. 16 year 2007 recommend that primary and secondary science teachers must have an interdisciplinary tendency in science or integrated science to form a holistic mindset of students as a life skill in solving problems in their lives (Susilowati, 2013; NSTA, 2003; Lestari, 2013).

One integrated learning model is an immersed model. The immersed model is designed so that each individual integrates all data from each field of science according to his field of interest. The teacher fosters students' interest through challenging projects, so students will seek and integrate all relevant information to complete the project (Fogarty, 2009). Project-based learning (PjBL) allows students to use their own knowledge to solve real problems in the form of projects (Bilgin, Karakuyu, & Ay; 2015). The characteristics of this model are consistent with the characteristics of the immersed integrated model. PjBL is curriculum-based contextual learning based on real questions or problems that are challenging, involves students in choosing topics, considering approaches, designing, solving problems, making decisions, providing opportunities to work freely for a long time, and producing real products related problems (Diawati, Liliasari, Setiabudi, & Buchari ; 2017). PjBL model can improve high-level thinking skills, including creative thinking skills (Diawati, Liliasari, Setiabudi, & Buchari, 2017; Bell, 2010; Zhou, Jette, Anette, & Jens, 2010; Kokotsaki, Menzies, & Wiggins, 2016). Creative thinking skills need to be trained so students can solve problems (Couglan, 2007; Bacanli, Dombacyl, Demir, & Tarhan, 2011).

Creative thinking is a skill to develop, discover or create new constructive combinations through an inquiry process based on data, existing information with different points of view that appear as manifestations of perceived problems, resulting in useful solutions (Diawati, et. al., 2017). There are 5 indicators of creative thinking skills, which are fluency, flexibility, originality, elaboration, and evaluation (Bell; 2010). Creative thinking skills can be trained by involving students in solving real problems in the form of projects (Diawati, et. al., 2017; Cheng, 2010).

The real problem in the environment of Purbolinggo subdistrict is the amount of cassava peel waste that accumulates around the tapioca factory which has an impact on environmental pollution in the area. This learning-based on cassava peel waste treatment projects requires various concepts such as environmental pollution and biotechnology. Students are challenged to creatively solve the problem of cassava peels waste by using their knowledge. In this article, the products of the development performance assessment are based on real-life problems such as the cassava peel waste project, this is the novelty in this research. In addition to changing the learning model and environment, to train creative thinking skills, it is necessary to change the assessment method to measure student achievement. Assessment is a foundation that has an important impact on the learning process. Assessment methods that are not congruent with learning methods and objectives will make learning innovations meaningless because they are not following the student learning process (Diawati, 2017).

In integrated science learning based on the project of cassava peel waste treatment, the acquisition of students' creative thinking skills assessed in various ways; one of them is performance-based assessment (Bergh, 2006; Barak and Doppelt, 2000). Based on the literature review, traditional assessment methods consider less appropriate to measure the level of understanding and skill acquisition through project-based learning (Dori, 2003; Frank & Barzilai, 2004; Krajcik, Czerniak, & Berger, 1999). However, in reality, the assessment instruments for creative thinking skills that widely developed are test assessments; for example, those developed by Torrance (1974, 1996), Shukla and Sharma (1986), Hu and Adey (2002); Aktamis, et., al. (2005), Sak and Ayas (2013), and Siew, Chong, Chin (2014). A performance assessment to measure creative thinking skills recently developed by Diawati (2017). The performance assessment instrument designed to measure creative thinking skills of undergraduate preservice chemistry teacher in project-based learning lab apparatus modification of chemistry of instruments. Based on the literature review, the development of performance assessment instruments for creative thinking skills is still very limited.

▪ METHOD

The method in this research is research and development by using a 4D model developed by Thiagarajan (1974). This model consists of four stages, which are defined, designed, developed and disseminated (Thiagarajan, Semmel, & Semmel; 1974). However, the 4D model carried out only reached the develop stage. In the define stage, study of literature and prior study are carried out according to the teacher related to the assessment system used in learning activities. Furthermore, at the design stage, planning and preparation of the initial draft of the instrument of performance assessment are carried out. At the develop stage, validation is carried out by two science education experts. Validation of performance assessment instruments includes aspects of construction and content suitability based on the framework of Torrance's creative thinking skills indicators aspects, namely originality, fluency, flexibility, and elaboration. The number of statements in the content suitability questionnaire consists of 32 items and the construction aspect consists of 5 statements. Statements in the content suitability questionnaire include the suitability of student tasks and rubrics on indicators of creative thinking skills. The statement in the construction aspect questionnaire contains the completeness of the performance assessment instrument, namely the existence of a task component that can measure creative thinking skills and a scoring rubric. Furthermore, the assessment instrument is revised according to suggestions from expert validators to produce appropriate assessment devices. Then, the validation data is calculated using a formula:

$$\% X_{in} = \frac{\sum S}{S_{maks}} \text{ x } 100\%$$

In which $\% X_{in}$ is the percentage of respondents' answers on the questionnaire, $\sum S$ is the number of answer scores, and S_{maks} is the expected maximum score (Sudjana; 2005). Scoring on the results of filling out questionnaires for content suitability aspects used an assessment of four choices namely SS (strongly agree), ST (agree), KS (less disagree), and TS (disagree). Each choice has a different score. In SS = 4 statement, ST = 3, KS = 2 and TS = 1. In the construction aspect, use an assessment with "Yes" and "No" answer choices. Scores for statement "Yes" = 2 and "No" = 1. After knowing the answer score on the questionnaire, it calculates the average percentage of answers on each questionnaire using the formula of $\overline{\%Xi}$

$$\overline{\%Xi} = \frac{\sum \%Xin}{n}$$

In which, $\overline{\%Xi}$ is the average percentage of answers to the statements on the questionnaire, $\sum\% X_{in}$ is the number of percentage answers to all statements on the questionnaire, and n is the number of statements on the questionnaire (Sudjana; 2005). The results of the calculation of each aspect are interpreted according to Arikunto based on "very low" to "very high" criteria. Then, it calculates the average percentage of content and construction aspects. The results of the calculation of the validity level of performance assessment products are interpreted with criteria "valid/feasible" to "invalid/ inappropriate" (Arikunto, 2010). After being validated by experts, the next step is to conduct an initial field trial that aims to determine the teacher's response to the product being developed. Field trials were carried out at SMP Negeri 1 Purbolinggo.

▪ RESULT AND DISCUSSION

The results of the literature study and preliminary study at the define stage with the science teacher at SMP Negeri 1 Purbolinggo showed that teachers tended to conduct performance assessments through the provision of tests or objective forms and the absence of performance assessment instruments and guidelines that could be used as a guide for teachers to develop creative thinking skills students in project-based immersed integrated science learning programs.

In the design stage, design and make the initial draft in the form of a performance assessment device by considering the results of the define stage that was previously given. The draft produced is a performance assessment consisting of 16 task indicators of creative thinking skills. Each task has the highest score of 4 and the lowest 1. The statements displayed in the performance assessments have been compiled based on Torrance's framework of indicators of creative thinking skills such as asking several questions (fluency), general ideas (flexibility), new and unique ideas (originality), and perfecting ideas (elaboration) (Torrance; 2000). After the draft performance assessment device has been produced, at the develop stage, a validation of the performance assessment device is carried out to determine the validity/feasibility of the instrument.

Validation results were carried out by the validator to assess the suitability aspects of the content to indicators of creative thinking skills and construction aspects of the task that measures creative thinking skills. The number of statements in the content suitability questionnaire consists of 32 items and the construction aspect consists of 5 statements. The validator is assessed in the form of a questionnaire by giving a checkmark in the column provided in each statement and writing suggestions for the improvement of the performance assessment that has been developed. The average percentage of validators from the performance assessment can be seen in Table 1.

Table 1. Results of expert validation

Rated aspect	Percentage Average	Criteria
Content suitability	96%	Very High
Construction suitability	100%	Very High

The content suitability aspect has an average percentage rating of 96% with very high criteria. In this aspect the validator does not provide suggestions, meaning that the

performance assessment instrument is suitable for measuring students' creative thinking skills such as asking several questions (fluency), general ideas (flexibility), new and unique ideas (originality) and perfecting ideas (elaboration). In the construction aspect, the average percentage of evaluation is 100% with very high criteria. In this aspect, the validator does not give any advice, so that the performance assessment instrument already has a task measured on the performance sheet based on indicators.

After being validated by experts, the next step is to conduct an initial field trial that aims to determine the teacher's response to the product being developed. Field trials were carried out at SMP Negeri 1 Purbolinggo. Respondents in this initial field trial were 3 science teachers who taught at SMP Negeri 1 Purbolinggo. The initial testing process carried out on the teacher is the same as in the expert validation process, namely asking the teacher's response about aspects of the suitability of the content with indicators of creative thinking skills and construction aspects. Each item contained in the teacher's response questionnaire is the same as the statement contained in the expert validation instrument. The average percentage of the results of the initial field trials based on teacher responses can be seen in Table 2.

Table 2. Initial field test results based on teacher's responses

Rated Aspect	Percentage Average	Criteria
Content suitability	94%	Very High
Construction	97%	Very High

The content suitability aspect has an average percentage rating of 94% with very high criteria. It shows that the performance assessment instrument matches the indicators of creative thinking skills according to Torrance's framework. In the construction aspect, the average evaluation percentage is 97% with very high criteria. In this aspect, the teacher does not give any advice, so that the performance assessment instrument has good construction. An example of a performance assessment item is shown in Figure 1.

6.	Menggagas rincian alat dan bahan proyek pengolahan limbah kulit singkong. (*elaboration*)	Jika menggagas rincian alat dan bahan proyek yang digunakan sebanyak >3 dan konsepnya benar	Jika menggagas rincian alat dan bahan proyek yang digunakan sebanyak 3 dan konsepnya benar	Jika menggagas rincian alat dan bahan proyek yang digunakan < 3 dan konsepnya benar	Jika menggagas rincian alat dan bahan proyek yang digunakan namun tidak ada yang benar
7.	Menggagas rincian alat dan bahan yang berbeda dengan proyek pengolahan limbah kulit singkong pada umumnya. (*originality)*	Jika mengagas rincian alat dan bahan proyek yang berbeda dengan alat dan bahan yang digunakan pada umumnya dan konsep-nya benar	Jika menggagas rincian alat dan bahan proyek yang berbeda dengan alat yang digunakan pada umumnya namun beberapa diantaranya tidak sesuai konsep	Jika mengagas rincian alat dan bahan proyek yang sudah digunakan orang pada umunya dan semua konsepnya benar	Jika mengagas rincian alat dan bahan proyek yang sudah digunakan pada umumnya dan diantaranya sesuai konsep

Figure 1. An example of a performance assessment item

▪ CONCLUSION

The results of expert validation showed that the average percentage of content suitability aspects to the indicators of creative thinking skills was 96% with very high criteria, while the construction aspects of the task which measured creative thinking skills were 100% with very high criteria. The average percentage of teacher responses to content suitability aspects to indicators of creative thinking skills and construction of

tasks that measure creative thinking skills are 94% and 97% respectively with very high criteria. Based on this result, the performance assessment instrument produced from this study is valid and feasible to measure creative thinking skills in a project-based learning program based on cassava peel waste issue.

▪ REFERENCES

Aktamıs, H., Pekmez, E. ., Can, B. T., Ergin, Ö. (2005). Developing scientific creativity test. University of Dokuz Eylul. Diakses tanggal 30 Oktober 2016, pada https://www.clab.edc.uoc.gr/2nd/pdf/58. pdf

Al-Suleiman, N. (2009). Cross-cultural studies and creative thinking abilities. *Journal of Education and Psycologic Science,* 1, 42-29

Arikunto, S. (2012) *Dasar-dasar Evaluasi Pendidikan (Edisi 2).* Jakarta: PT Bumi Aksara.

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

Bacanli, H., Dombacyl, M.A., Demir, M., and Tarhan, S. (2011). Quadruple thinking: creative thinking *Procedia Social and Behavioral Sciences,* 12**,** 536-544

Barak, M., Doppelt, Y. (2000). Using portfolios to enhance creative thinking. The Journal of Technology Studies, 26(2), 16–24.

Bell, S. (2010). Project-based learning for the 21st century for the future *Taylor & Francis Group.* 83, 39-43

Bergh, V., dkk. (2006). New assessment modes within project-based education–the stakeholders. *Studies in Educational Evaluation,* 32, 345–368.

Bilgin, I., Karakuyu, Y., and Ay, Y. (2015.) The effect of project-based learning on undergraduate students' achievement and self efficacy beliefs towards science teaching. *Eurasia Journal of Mathematics Science and Technology Education,* 11, 469-477

Cheng, V.M.Y. (2010). Teaching creative thinking in regular science lessons: potentials and obstacles of three different approaches in an asian context. *Asia-Pacific Forum on Science Learning and Teaching,* 11, 1-21

Couglan, A. (2007). *Learning to Learn: Creative Thinking and Critical Thinking.* DCU Students Learning Resources

Diawati, C.; Liliasari; Setiabudi, A.; Buchari. (2017). Students' construction of a simple steam distillation apparatus and development of creative thinking skills: a project-based learning. *International Seminar on Mathematics, Science, and Computer Science Education-2016, AIP Conference Proceedings*; Hidayat, T., et al., Eds.; 2016; Vol. 1848, pp 030002-1-030002-6. DOI: 10.1063/1.4983934

Dori, Y. (2003). A framework for project-based assessment in science education. In M. Segers, F. Dochy, E. Cascallar (Eds.), Optimising new modes of assessment: In search of qualities and standards (pp. 89- 118). Dordrecht: Kluwer

Frank, M., Barzilai, A. (2004). Integrating alternative assessment in a project-based learning course for pre-service science and technology teachers. Assessment & Evaluation in Higher Education, 29, 41–61.

Fogarty, R. (2009) *How to Integrate the Curricula Third Edition* (New York: Corwin A Sage Company)

Hu, W.P., Adey, P. (2002). A scientific creativity test for secondary school students. *International Journal of Science Education,* 24(4), 389–403.

Krajcik, J.S., Czerniak, C. & Berger, C. (1999). Teaching Children Science: A Project-Based Approach. Boston: McGraw Hill College

Kokotsaki, D., Menzies, V., and Wiggins, A. (2016). Project-based learning: a review of the literature. *Improving Schools,* 19, 1-11

Lestari, S. (2013). *Pemahaman siswa smp pada pembelajaran terhubung (connected teaching) untuk konsep pencemaran lingkungan* Available at https://www.repository.upi.edu/3287/4/S_BIO_0908888_CHAPTER1.pdf

Listyawati M. (2012). *Pengembangan perangkat pembelajaran IPA terpadu di SMP*. [Development of integrated science learning tools in junior high school]. *DoubleClick: Journal of Innovative Science Education (JISE,)* 1, 61-69

National Science Teacher Assosiation (2003) *Standars for Science Teacher Preparation* Available at https://www.nsta.org/preservice/.../NSTAstandars2003.pdf

Nisak, K. (2013). *Pengembangan perangkat pembelajaran ipa terpadu tipe connected pada materi pokok sistem ekskresi untuk kelas IX SMP*. [Development of connected-type integrated science learning tools on the subject matter of the excretion system for class IX SMP]. *DoubleClick: Jurnal Pendidikan e-Pensa,* 2, 81-84

Ni'mah, L. H, Saptorini and Pamelasari S.D. (2013). *Pengembangan LKS IPA terpadu berbasis permainan edukatif tema gerak tumbuhan dan faktor yang mempengaruhi untuk siswa SMP*. [Development of integrated science worksheets based on educational games with the theme of plant movement and influencing factors for junior high school students]. *DoubleClick: Unnes Science Education Journal,* 2, 149-156

Sak,U., Ayas, B. (2013). Creative scientific ability test (c-sat): a new measure of scientific creativity. Psychological Test and Assessment Modeling, 55(3), 316–329

Siew, N.M., Chong, C.L., Chin, K.O. (2014). Developing a scientific creativity test for fifth graders. *Problems of education in the 21 st century*, 62, 109–123.

Susilowati. (2013). *Integrated science worksheet pembelajaran IPA SMP dalam kurikulum 2013 (*Makalah Diklat Pengembangan Student Worksheet Integrated Science bagi Guru SMP/MTs 24 dan 31 Agustus 2013 (Sleman : Jawa Tengah)

Shukla, J.P., Sharma, V.P. (1986). Manual for Verbal Test on Scientific Creativity. National Psychological Corporation, Agra.

Sudjana. (2005) *Metode Statistika.* Bandung: Tarsito

Thiagarajan, S., Semmel, D.S., & Semmel, M.I. (1974). *Instructional Development for Training Teachers of Expectional Children:A Sorcebook.* Indiana: Indiana University

Torrance, E.P. (1974). Torrance Test of Creative Thinking. Lexington, MA: Personnel Press.

Torrance, E. P. (1966). The Torrance Tests of Creative Thinking – Norms Technical Manual.

Torrance, E.P. (2000). Research Review for the Torrance Test of Creative Thinking: Verbal and Figural Forms A and B. Bensenvile, IL: Scholastic Testing Service

Zhou, C., Jette, E.H., Anette, K., & Jens, D.N. (2010). Creativity development for engineering students: cases of problem and project based learning. *Joint International IGIP-SEFI Annual Conference* (Trnava, Slovakia)