



# Validity of Student Worksheet Based on Model Creative Problem-Solving in Mixture Separation Material to Train Higher-Order Thinking Skills

Nur Sholikhah<sup>1\*</sup>, Hasan Subekti<sup>2</sup>, Ilkhfa Rizqy Ananda<sup>3</sup>, Anita Septi Amanda<sup>4</sup>

<sup>1,2,3,4</sup> Science Education, Faculty of Mathematics and Science, Universitas Negeri Surabaya, Surabaya, Indonesia

\*nursholikhah.21070@mhs.unesa.ac.id

**Abstract.** This research aims to develop a student worksheet based on Model Creative Problem-Solving in a Mixture of Separation Material and to know the validity criteria. The type of this research is Research and Development with the development model of Plomp which consists of three stages, namely the preliminary research phase, development phase, and assessment phase. The validity of the student worksheet based on CPS was achieved from the validation of the expert sheet by 5 experts. The result shows that the presentation term scored 93,3% with very valid criteria, the language term scored 93,3% with very valid criteria, the content term scored 93,75% with valid criteria, the design term scored 81,16% with very valid criteria and the average of all four conditions get 90,2% with valid criteria. The development of students' worksheets based on CPS in a mixture of separate materials was successfully developed with valid validation criteria and is expected to be a reference and guideline in helping students carry out the learning process, understand the available problems and solve it, and train to improve high order thinking skills.

**Keywords:** Validity, Student Worksheet, Creative Problem Solving

## 1 Introduction

Education is a deliberate and systematic effort to foster a learning environment and process that encourages students to actively develop their potential. This includes nurturing religious and spiritual strength, self-discipline, personal character, intelligence, ethical values, and the skills necessary for both personal growth and societal contribution. [1]. Education plays a role in preparing the younger generation to answer future challenges. This is in line with Indonesia's national education goals which focus on developing superior and characterful human resources. Meanwhile, science education, according to Sudjana (2009) in his book *Science Learning in Schools* is a learning process that equips students with knowledge and understanding of the universe and its contents. This process emphasizes developing curiosity, scientific attitudes, and critical thinking skills [2]. Furthermore, Hamalik (2004) in his book *Learning Models* explains that science education aims to prepare students to become individuals who have

scientific literacy, able to solve problems and adapt to change. Science education is not just about memorizing formulas and facts, but also about understanding concepts, conducting investigations, and building interpretations. [3] Through science education, students are invited to become active and independent learners in uncovering the mysteries of the universe.

In reality, there are still many problems in science education in Indonesia. One thing that is common is the low interest and learning outcomes of students in this subject. This is exacerbated by learning methods that are still traditional and lack emphasis on HOTS development. According to Darmadi & Sukmawati (2018), one of the factors causing the low HOTS of students in science learning is the lack of variety in learning methods used by teachers. Teachers still predominantly use lecture methods and give assignments, so students are not used to thinking critically and creatively. [4] This problem needs to be addressed with a comprehensive solution. One approach that can be applied is to implement HOTS-based science learning. This approach emphasizes developing students' critical thinking, analyzing and solving problems through various creative and innovative learning activities.

To overcome students' lack of training in solving a problem given by the teacher, a learning model is needed that can be applied in the learning process which is packaged contextually so that it can help students to improve their problem-solving abilities. Therefore, it is necessary to apply a learning model based on problem solving. One of them is the Creative Problem Solving (CPS) learning model. The Creative Problem Solving (CPS) Learning Model is a learning approach that focuses on developing creative problem-solving abilities. This model emphasizes the importance of divergent and convergent thinking skills in finding innovative solutions to various problems. [5] According to Pepkin CPS is a learning model that focuses on teaching and developing problem solving abilities, followed by strengthening creative thinking skills. CPS is different from traditional learning models which only focus on delivering material and mastering concepts. The CPS model emphasizes students' active participation in the learning process. Students are encouraged to express their ideas freely, think critically, and work together to solve problems. [6]

The choice of the CPS learning model in the learning process is because first, CPS is included in the learning model with a constructivist approach, where the center of learning is the student (student centered) so it is considered capable of activating students. Second, the CPS learning model can be used with students with diverse intellectual abilities. Third, the CPS learning model is not only limited to the level of recognition, understanding and application of information, but also trains students to analyze a problem and solve it. Fourth, the CPS learning model is easy to understand and apply at every level of education and every learning material [7]

HOTS indicators or high-level thinking skills are divided into four criteria, namely problem solving, decision making, critical thinking and creative thinking [8] Student's ability to use logic and the ability to reason to solve a problem and make a decision is an indicator of logical thinking, while the ability to create new ideas, concepts and concepts is the ability to think creatively. [9] (Therefore, research was conducted that aims to identify types of project-based assignments that meet the HOTS

criteria and measure the level of success in the quality of assignments using an authentic assessment approach. It is hoped that by measuring this level of quality, the project-based lecture process can be easily understood and can still train students' ability to think at a higher level or in other words Higher Order Thinking Skill (HOTS).

Learning media in learning and teaching activities is an entity that cannot be separated from the world of education. Learning media is something that can be used to channel messages from the sender to the recipient so that it can stimulate students' thoughts, feelings, attention, and interest in learning.[10]. Learning media that suits the needs of learning activities will create an effective and efficient learning activity so that the material delivered by the teacher to students can be absorbed optimally. The presence of media in the learning process helps students better understand what they are learning. Therefore, the selection and use of media must be truly appropriate so that the desired goals can be achieved easily. Ultimately, the use and use of media supports effectiveness, efficiency, and attractiveness in learning.[11]

Learning media is a medium that can provide learning stimulation to students to encourage students to be more motivated to learn something. There are several types of teaching materials, namely direct teaching materials and indirect teaching materials. One of the direct teaching materials is the student worksheet [11] Currently, due to the development of digital technology, there are digital-based interactive student worksheets. student worksheet is a collection of sheets containing student activities that allow students to carry out real activities with the objects and problems being studied. Apart from that, student worksheet is printed teaching material that contains guides that students can use to develop their abilities[12]

In learning activities, the student worksheet functions as a study guide for students and also makes it easier for students and teachers to carry out teaching and learning activities. Learning using student worksheet is effective in improving student's learning outcomes, knowledge, attitudes, and skills [13]. student worksheet can make it easier to understand the material as well as make observations and practice experiments both inside and outside the classroom. student worksheet that utilizes electronic media is often referred to as interactive student worksheet. Interactive student worksheet is an alternative media that can be used to support the learning process consisting of material and practice questions which are classified as digital-based media because to run them, electronic media is needed which allows students to increase their insight into the learning material independently.

The use of digital technology is an effective means of increasing people's active participation in the world of education. Currently, digital implementation in the world of education is not yet optimal to increase the absorption capacity of Indonesian students for access to educational content or improve digital-based skills. Based on 2018 Central Statistics Agency data on the Use and Utilization of Information and Communication Technology (P2TIK), the education sector shows that more than 20% of schools in Indonesia do not have access to the Internet and only 7.64% of teachers teach digital skills (BPS, 2018). This indicates that the government's homework to accelerate development in the education sector through the role of technology requires serious

attention. Through the use of digital-based interactive student worksheet, it can certainly be a solution to improve education in Indonesia in achieving Sustainable Development Goals (SDGs) point 4. Point 4 of SDGs is quality education.

One type of interactive student worksheet is the electronic student worksheet, which is a digital practice sheet completed systematically and continuously over a certain period. Electronic student worksheets can be designed and customized to align with specific learning objectives and the creativity of each teacher. Students can access these worksheets online, which helps them better understand the material provided by the teacher, thereby facilitating the achievement of learning goals. Based on this, it is essential to develop electronic student worksheets that train higher-order thinking skills (HOTS) as a learning medium, with the aim of enhancing the quality of education in Indonesia.

## 2 Method

This type of research is research and development. This research can produce new products that have been validated and can be used in the learning process, and can improve student learning outcomes. [15]. The development of CPS-based student worksheets on mixed division material uses the Plomp model. The Plomp development model consists of three stages, namely the initial discovery stage (preliminary research), the development or prototyping stage (development or prototype stage), namely assessment (assessment) [16]. The choice of the Plomp model was based on considerations, this model combines research with practical aspects of instructional design, which allows the development of systematic and structured educational solutions for designing education or developing open materials

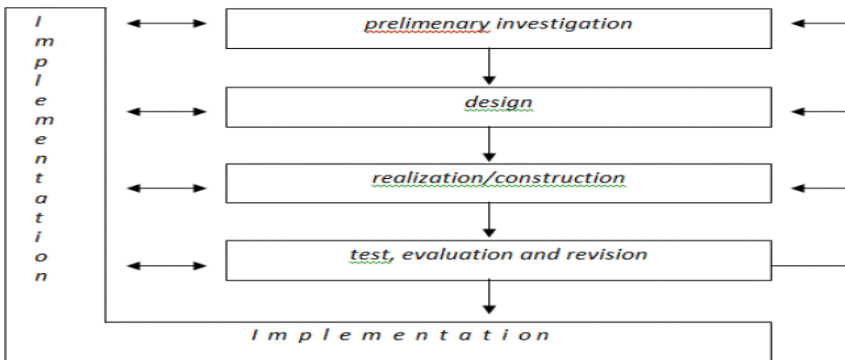


Fig. 1. Plomp Development Model (Source: Plomp, 1997)

At the preliminary investigation stage, analysis of student problems and needs, student analysis, curriculum analysis, and student worksheet analysis were carried out. This was obtained through interview observations and literature studies. At the

development or prototyping stage, there is the development of a student worksheet prototype. At the development and prototyping stage, students' worksheets are equipped with research instruments.

In the assessment stage, both validity and practicality are evaluated. Validity is determined by experts, while practicality is assessed based on its applicability for teachers and students. However, this research focuses only on the validity stage. Validity serves as a measure of the accuracy and credibility of the developed product. It ensures that the assessment tool accurately evaluates the intended concept, effectively measuring the aspects that need to be assessed. Validity encompasses the accuracy, relevance, and usefulness of the conclusions, as guaranteed by expert evaluation.

The validity testing of the Student Worksheet prototype was conducted by evaluating it with several experts. Specifically, validation was performed by five experts, who are science teachers at SMP Negeri 1 Bagor, Nganjuk. Based on the experts' suggestions and comments, revisions were made to ensure that the student worksheets align with user needs and effectively support the learning process. The validity analysis was conducted using data collected from questionnaires filled out by these experts, providing insights into the worksheet's validity.

Data analysis started with specified scores for each item, with validation score specified based on the scale Likert[17]

**Table 1.** Scale Likert

Scale	Criteria
4	Very good
3	Good
2	Good less
1	Very Less

Next, the percentage of data calculated using a Likert scale is calculated using the following formula:

$$\text{Percentage (\%)} = \frac{\text{total score}}{\text{maximum total score}} \times 100\% \quad (1)$$

Decide, maximum total score = highest value × total aspects × total validators

The results of calculating the scores obtained by each student are translated according to the value interpretation criteria contained in Table 2 below.[17]

### 3 Results and Discussion

The validity of the Student Worksheets based on Creative Problem-Solving Models for Mixed Separation Materials, aimed at practicing higher-order thinking skills, is determined using expert validation instruments. These instruments are aligned with the

steps of the Creative Problem-Solving (CPS) model, leading to the development of the Student Worksheets. The worksheets are then validated exclusively by experts in the relevant field, ensuring a thorough assessment of their effectiveness and quality. Student worksheets that meet the requirements must fulfill several aspects including presentation aspects, language aspects, content aspects and design aspects[18]. The validity period of the Student Worksheet Based on Creative Models for Problem Solving in Separating Mixed Materials includes presentation requirements, language requirements, content requirements and design requirements that must be met with valid criteria. The validators who provided assessments of this validation process were 5 science teachers at SMP Negeri 1 Bagor. The results of validation creative problem-solving student worksheets are as follows:

**Table 3.** Presentation aspects validity result

No	Aspect Components	Validator Assessment					Total	percentage	Criteria
		V1	V2	V3	V4	V5			
1	Clarity of material reporting	4	4	4	4	4	20	93.3%	Very valid
2	Illustration/image settings	4	2	4	4	3	17		
3	Layout settings	4	4	4	4	3	19		
Total		12	10	12	12	10	56		

**Table 4.** Language aspects validity result

No	Aspect Components	Validator Assessment					Total	percentage	Criteria
		V1	V2	V3	V4	V5			
1	Conformity of the language used with Indonesian language rules	4	4	4	4	3	19	93 %	Very valid
2	Simplicity of sentence structure	3	4	4	4	3	18		
3	Clarity of instructions and directions	3	4	4	3	4	18		
4	The question sentence does not contain double meaning	3	4	4	4	4	19		
5	The language used is communicative	3	4	4	4	3	19		
Total		17	20	20	19	17	93		

**Table 5.** Content aspects validity result

No	Aspect Components	Validator Assessment					Total	Percentage	Criteria
		V1	V2	V3	V4	V5			
1	Conformity of content with indicators of	3	4	4	4	4	19	93.75%	Very valid

	achievement of learning outcomes							
2	The correctness of the content/material supports the clarity of the material	3	4	4	4	4	19	
3	Suitability of LKPD to student needs	3	4	4	4	3	18	
4	Feasibility as a learning tool media	3	4	4	4	4	19	
	Total	12	16	16	16	15	75	

**Table 6.** Design aspects validity result

No	Aspect Components	Validator Assessment					Total	Percentage	Criteria
		V1	V2	V3	V4	V5			
1	The appearance of the layout on the LKPD cover (title, illustration, logo, etc.) is arranged harmoniously	3	3	4	4	3	17	81,16%	Very valid
2	The letters used are attractive and easy to read	3	4	4	3	4	18		
3	The layout (title, illustration) of each page is consistent	3	4	4	4	4	19		
4	Didn't use too many fonts	3	4	4	4	3	18		
5	The colors and layout are harmonious and clarify the function	4	4	4	4	3	19		
6	The images presented are attractive and support the clarity of the material	3	2	4	3	3	15		
	Total	19	21	25	22	20	107		

The validity of the data obtained from validation results using expert validation sheets includes presentation aspects, language aspects, content aspects and design aspects. Regarding the validity value in the presentation aspect, the criterion value was 93.33% with very valid criteria. The student worksheet is designed according to indicators of clarity, effectively presenting the material with well-arranged illustrations and layout of objectives. The activities within the worksheet are integrated with the Creative Problem-Solving (CPS) model, ensuring that the material is clearly depicted and accurately represented.

The validity value of the language aspect is 93.3% describe valid criteria. Means that the language presented on student worksheets has been developed following the suitability of the language used with Indonesian language rules, simplicity of sentence structure, clarity of instructions and directions, sentences that do not contain double meanings and the language used is communicative. Meanwhile, the value of the content validity aspect is 93.7% with very valid criteria. Shows that the student's worksheet has appropriate content with indicators of achievement of learning outcomes, the

correctness of the content/material supports the clarity of the material, the suitability of the LKPD to the needs of students and its suitability as a learning tool and the validity of the design criteria aspect is 81.16% with valid criteria. The student worksheet effectively presents a well-organized layout on the cover, including the title, illustrations, logo, and other elements in a harmonious manner. The fonts used are visually appealing and easy to read, with a consistent layout for titles and illustrations across each page. The design avoids excessive use of different fonts, colors, and layouts, maintaining a balanced appearance that enhances its functionality. Additionally, the images included are both attractive and help to clarify the material.

The overall validity calculation resulted in an average score of 90.2%, indicating very strong validity. Thus, it can be concluded that the Student Worksheets based on Creative Problem-Solving Models for Mixed Separation Materials are effective as a guide. These worksheets encourage active student participation in the learning process, helping students to better retain and comprehend the material through problem-based learning. Additionally, they enhance student competencies across cognitive, affective, and psychomotor domains while also fostering higher-order thinking skills

## 4 Conclusions

Based on the research findings and discussion, it can be concluded that the validity of the Student Worksheets based on Creative Problem-Solving Models in Mixed Separation Materials has been successfully established. These worksheets serve as a valuable resource for guiding students toward more active learning and enhancing their academic performance. The Student Worksheets, grounded in Creative Problem-Solving Models for Mixed Separation Materials, achieved an average validity score of 90.2% across presentation, language, content, and design aspects. Therefore, these developed worksheets are effective tools for use in the learning process, helping students engage with and solve problems, and fostering the development of higher-order thinking skills.

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## References

1. Rahman: Understanding Education, Educational Science and Elements of Education. Al-Urwatul Wutsqa 2(1), 1–2 (2022)
2. Sudjana: Science learning at school. Sinar Baru Al Insani, Bandung (2009)
3. Hamalik, O.: Learning Models. PT. Bumi Aksara, Jakarta (2004)



4. Darmadi, Sukmawati,: Analysis of the Higher Order Thinking Skills (HOTS) Ability of SMPN 16 Bandung City Students on Photosynthesis Material. *Journal of Science Education Studies* 6(2), 223–232 (2018)
5. Pepkin, K. L.: *Creative Problem Solving in Math.* (2004)
6. Saminanto, K.: Creative Problem Solving (CPS) Learning Model to Improve Elementary School Students' Creative Thinking Abilities. *Journal of Elementary Education* 10(2), 123–134 (2011)
7. Asikin, Pujiadi,: The Influence of the Creative Problem Mathematics Learning Model Solving Problem Solving Abilities in Class X High School Students. *Lembaran Ilmu Kependidikan* 37(1) (2008)
8. Yuniar, M., Rakhmat, C., Saepulrohman, A.: The Analyses of HOTS (High Order Thinking Skills) in Objective Test in Social Studies Class 5 th SD Negeri 7 Ciamis, *Pedagogics: Scientific Journal of Primary School Teacher Education* 2(2), 187–195 (2015)
9. Fatimah, Pahlevi,: Development of a HOTS (Higher Order Thinking Skills) based assessment instrument on basic competencies implementing an alphabetical archival system. *Journal of Educational Administration* 8(7), 318–328 (2020)
10. Gammi, A.: *Eveloping Learning Media Using Flashcard Media from Scraps to The Young Learners of Kampung Cerdas Rusunawa Pontianak.* IKIP PGRI PONTIANAK (2022)
11. Firdaus, M., Wilujeng, I.: Development of guided inquiry worksheet to improve critical thinking skills and student learning outcomes, *Jurnal Inovasi Pendidikan IPA* 4(1) 26–40 (2018)
12. Prastika, Y., Masniladevi: Development of Interactive E-LKPD with Many Regular and Irregular Facets Based on Live Worksheets on the Learning Outcomes of Class IV Elementary School Students, *Journal of Basic Education Studies* 4(1) (2021)
13. Ariani, D., Meutiawati,I.: Development of Student Worksheets Based on Discovery Learning on Health Materials in Midle High School. *Jurnal Phi; Jurnal Pendidikan Fisika dan Fisika Terapan.* 1(1), 13-15 (2020)
14. Lathifah, M.F., Hidayati, B.N., Zulandri, Z: Efektifitas LKPD Elektronik sebagai Media Pembelajaran pada Masa Pandemi Covid-19 untuk Guru di YPI Bidayatul Hidayah Ampenan. *Jurnal Pengabdian Magister Pendidikan IPA* 4(2) (2021)
15. Wardinin, N., Lufri: Student Worksheet Validity Based on Problem Based Learning (PBL) Equipped with Educational Games in Biological Science Materials for Junior High School Grade VIII. *Proceedings of the 1st Progress in Social Science, Humanities and Education Research Symposium (PSSHRS) 2019, Paris, France: Atlantis Press, (2020)*
16. Plomp, T.: *Educational Design Research: An Introduction.* In T. Plomp & N. Nieveen (Eds.). Enschede, The Netherlands: SLO (2013)
17. Riduwan: *Research Variables Measurement Scale.* Alfabeta, Bandung (2012)
18. Wulandari, S., Arsih, F., Fajrina, S.: Validity of the Problem Based Learning (PBL) Mutation Teaching Module. *JOTE: Journal on Teacher Education* 4(4), 234–241 (2023)

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