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Assessing the Validity and Effectiveness of Student Worksheets and Creativity Tests in Enhancing the Creativity of Open University Students

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Abstract

This research aims to create valid and effective Student Activity Sheets (SAS) and Scientific Creativity Tests (SCT) in order to enhance the creativity of open university students. The validity of SAS and SCT is determined by achieving a minimum score of 2.50 in both content validity and construct validity categories. Similarly, their effectiveness is measured by: (1) observing a statistically significant increase in students' scientific creativity at a 5% significance level; and (2) achieving a minimum average n-gain in the medium category. This research follows an Educational Design Research approach and utilizes a pre-experimental design with a one-group pre-test and post-test design. The research subjects consist of undergraduate students at Open University Surabaya during the 2023/2024 academic year. The data collection instruments used in this research include: (1) a Validity Assessment Sheet for SAS and SCT; and (2) the SCT test. The research data, which includes pre-test and post-test scores, are collected after conducting prerequisite tests such as normality and homogeneity tests. These scores are then analyzed using a paired t-test to identify any differences in students' scientific creativity between the pre-test and post-test stages. The average level of improvement in scores is calculated using the normalized gain (N-gain) method. The research data, in the form of scores obtained from the assessments of the validity of learning tools by three Learning Experts, are analyzed using the average method to determine validity, as well as by using Cronbach's alpha (α) to assess reliability. The same analysis is conducted for the Research Instrument scores. The research findings demonstrate that both SAS and SCT tools are valid and effective in enhancing student creativity.

Keywords: Validity; Effectiveness; SAS; SCT; Student Creativity

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INTRODUCTION

The development and application of innovative educational tools are crucial in meeting the curriculum demands of the 21st century. Within the framework of the Indonesian National Qualifications Framework (KKNI), the integration of diverse and applicable skills is emphasized to meet global educational demands. The KKNI also stresses the importance of nurturing creativity and innovation among students by integrating attitude, values, work ability, scientific proficiency, and responsibility into educational outcomes. This holistic approach not only enhances technical skills but also fosters a comprehensive set of competencies. The government's commitment to implementing KKNI reflects its dedication to improving educational standards and aligning them with international benchmarks.

The need for effective educational tools is evident in the challenges faced in fostering creativity among elementary school preservice teacher students. Research shows that

misconceptions about creativity among teachers can hinder the development of creative competencies. Additionally, the lack of effective strategies to promote creativity in classroom settings highlights a significant gap in teacher preparation programs. In response to these challenges, the introduction of Student Activity Sheets (SAS) and Scientific Creativity Tests (SCT) within the Basic Social Sciences Concepts course at the Open University aims to directly address these gaps. These tools are expected to enhance the scientific creativity of students, thereby improving the quality of future educators and contributing to educational standards within the region. This initiative also offers a model that can potentially be replicated across various educational settings to further address broader educational challenges. The ultimate goal is to provide students with capabilities to engage creatively in problem-solving and innovation, preparing them for the complexities of the modern world. The study of these tools' effectiveness fills a significant gap in current educational practices and contributes to the global discourse on educational quality and innovation. One of the main issues is the lack of alignment between educational strategies and the creative processes that drive genuine innovation in academic and professional environments (Suyidno et al., 2018; Zulkarnaen et al., 2017). This misalignment is often worsened by traditional teaching methods that do not fully leverage the potential of modern educational tools to foster a creative thinking and problem-solving environment (Jatmiko et al., 2018; Prahani et al., 2018). Additionally, although there is a growing recognition of the importance of creativity in educational success, the methodologies used to teach and assess creative skills have not kept pace. Existing measures, while well-intentioned, have often failed to validate and effectively develop the desired creative abilities in students (Dwikoranto et al., 2020). This gap is evident in primary teacher education programs, where concerns about the declining quality of graduates persist (Harvey et al., 2010).

In addition to these pedagogical and methodological deficiencies, there is a noticeable lack of empirically tested educational tools specifically designed to enhance creativity in the scientific domain. Current tools and interventions, such as Student Activity Sheets (SAS) and Scientific Creativity Tests (SCT), have not been universally adopted or validated in different educational contexts, limiting their potential impact (Büyük & Koç, 2020; Genek & Küçük, 2020; Nacaroğlu & Mutlu, 2023). Furthermore, the effectiveness of these tools in different cultural and educational settings has not been adequately explored, raising questions about their generalizability and adaptability (Mercan & Köseoğlu, 2022; Tran et al., 2021). This is particularly important as educational frameworks and student demographics vary significantly across regions, necessitating a more customized approach to implementing and evaluating educational innovations (Akcanca & Ozsevgec, 2017). Another pressing issue concerning the need for a clearer understanding of the factors that contribute to the successful implementation of creativity-enhancing tools in education. Studies suggest that both teacher preparedness and the learning environment play crucial roles in fostering creativity among students (Chan & Yuen, 2015). However, there is a lack of comprehensive strategies to effectively address these factors, which hampers the overall goal of enhancing creative capacities in educational institutions. Another significant challenge is accurately assessing creativity as a multidimensional construct. Traditional assessment methods often fail to capture the complexity of creative processes and outcomes, resulting in a gap in measuring and understanding the impact of educational interventions on student creativity (Diep et al., 2023). Although the framework and objectives set forth by educational standards such as the KKNI are commendable, several factors hinder the actualization of these goals. These include outdated pedagogical approaches, a lack of validated and adaptable educational tools, insufficient understanding of the environmental and instructional dynamics that influence creativity, and inadequate methods for assessing creative outcomes. Addressing these issues is crucial for advancing the educational agenda, which aims not only to foster creativity but also to effectively prepare students to meet the challenges and opportunities of the 21st century.

The implementation of SAS and SCT introduces a unique intervention aimed at fostering scientific creativity, an area often implicitly developed within curriculum structures. Unlike

traditional methods that emphasize rote memorization and standardized testing, SAS and SCT are designed to encourage creative thinking processes, aligning with modern pedagogical theories that advocate for active learning and problem-solving skills as central to educational success (Ayas & Sak, 2014). This research diverges from typical educational strategies by integrating these tools within the Basic Social Sciences Concepts course, targeting the foundational level of teacher education. The focus on primary teacher education (PGSD) students is particularly significant, addressing a gap in the existing literature and practice, where the enhancement of creativity is often not systematically addressed from the onset of teacher preparation (Harvey et al., 2010). Despite recognizing the importance of creativity in educational settings, there is a lack of empirical research on the effectiveness of tools like SAS and SCT in real-world educational environments. Previous studies have focused on theoretical aspects or limited their scope to controlled experimental settings, which do not fully capture classroom dynamics and student interactions (Büyük & Koç, 2020; Genek & Küçük, 2020). Furthermore, the current literature provides limited insight into the long-term impacts of such interventions on student creativity. The adaptability and scalability of SAS and SCT in different educational contexts, cultural settings, and subject areas have not been thoroughly explored, creating a significant research gap (Nacaroğlu & Mutlu, 2023; Tran et al., 2021).

The context of this study is underscored by the Indonesian National Qualifications Framework (KKNI), which requires the integration of creative competencies into the curriculum. The KKNI emphasizes a holistic educational approach that incorporates knowledge, skills, attitudes, and competencies, providing a strategic framework for this study (Djati et al., 2022; Pangastuti & Fadhillah, 2020). The novelty of this research lies in its approach to translating these abstract competencies into tangible, assessable outcomes using innovative educational tools. By doing so, it addresses the need for empirically tested methodologies that can be adapted to diverse student and educator needs in a rapidly changing educational landscape.

The main objective of this study is to validate and evaluate the effectiveness of Student Activity Sheets (SAS) and Scientific Creativity Tests (SCT) as innovative tools to enhance student creativity at Open University. This objective aligns with the broader educational mandate of the Indonesian National Qualifications Framework (KKNI), which emphasizes the development of comprehensive competencies, including creativity and innovation (Djati et al., 2022; Pangastuti & Fadhillah, 2020). The primary aim is to determine whether SAS and SCT effectively foster an environment that promotes creative thinking and problem-solving. This entails assessing the validity of these tools in measuring and enhancing student creativity in line with current educational goals. The study will involve the structured application and systematic evaluation of these tools within the Basic Social Sciences Concepts course, focusing primarily on PGSD students at Open University.

METHOD

Research Design

The research design utilized in this study is Educational Design Research, as outlined by Nieveen et al. (2023). The objective of this research is to develop effective Strategies for Active Student Engagement (SAS) and Student-Centered Teaching (SCT) in lectures, with the ultimate goal of enhancing the scientific creativity of undergraduate students studying PGSD. The preparation of learning tools in lectures follows the Generic Design Research Model (GDRM) proposed by Wademan. The GDRM consists of the following steps: 1) identifying the problem, 2) tentatively identifying the product and design principles, 3) developing a tentative theory and product, 4) creating a prototype and evaluating the product, and 5) enhancing the quality of the product. The stages involved in preparing learning tools for lectures, based on modifications to the GDRM by Nieveen and Folmer (2013), are illustrated in Figure 1.

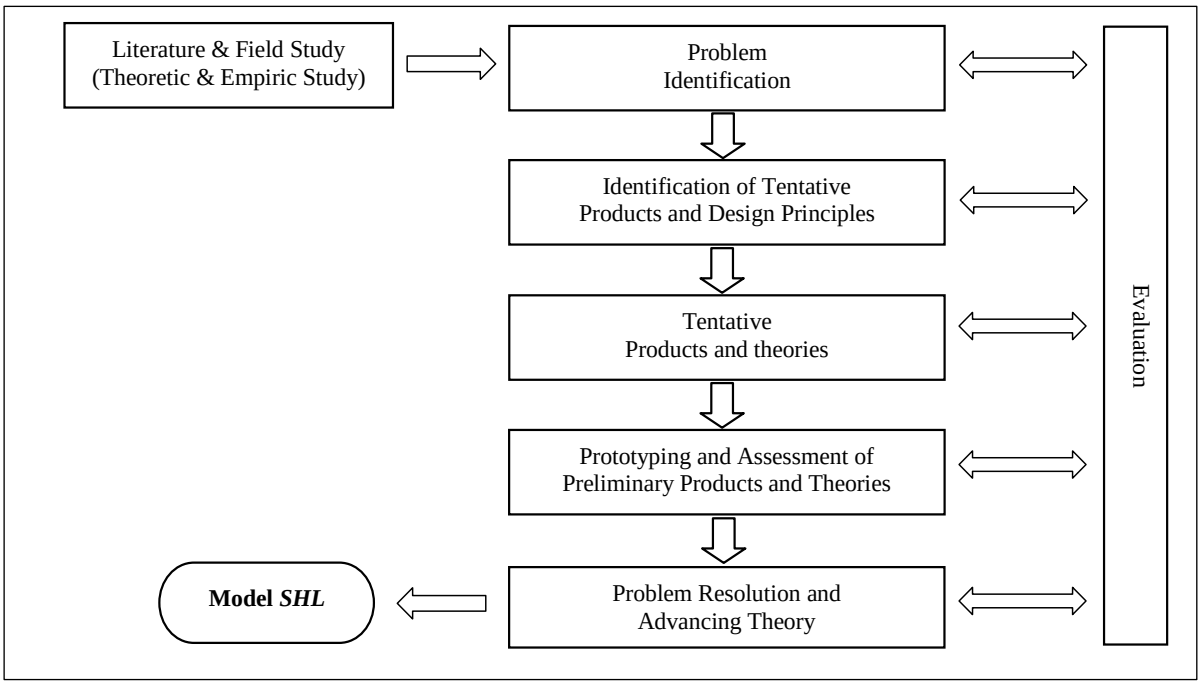

Figure 1 Stages of the Generic Design Research Model

This research is classified as Pre-Experiment Research using a one group pre-test and post-test design (Fraenkel et al., 2012) as presented in Figure 2.

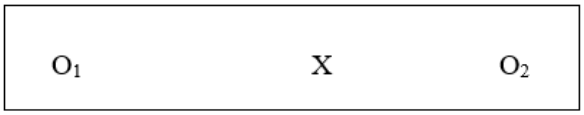

Figure 2 Type of Research

Information:
O_1: Pre-test score; O_2: Post-test score; X: Learning with SAS and SCT

Research Subject

The research subjects for the SAS and SCT trials were students in the Primary Teacher Education (PGSD) program at Open University UPBJJ-UT Surabaya's Undergraduate Department for the 2023/2024 Academic Year. These students were enrolled in the Basic Social Sciences Concepts course. Purposive sampling was used to select two classes, A and B. The research took place from May to November 2023 at UPBJJ-UT Surabaya.

Operational Definition of Research Variables

The operational definition of the research variables is as follows:

1. Validity of Learning Tools refers to the quality of Learning Tools, which include Student Activity Sheets (SAS) and Scientific Creativity Tests (SCT). These tools are assessed for content and construct validity by three experts using the Learning Tools Validation Sheet Instrument.
2. Effectiveness of using SAS in lectures is measured by the success of SAS in increasing students' scientific creativity. This is determined by: 1) a statistically significant increase in students' scientific creativity at $\alpha = 5\%$; 2) an average N-gain of students' scientific creativity falling within the minimum medium category; and 3) positive feedback from students.

Data Collecting

Data was collected through pre-test and post-test scores on students' scientific creativity before and after learning using SAS. Students took an initial test (pre-test) to measure their scientific creativity, and the same test was given again after the learning period (post-test). The

instruments used for data collection were the Learning Tool Validity Assessment Sheet and the Scientific Creativity Test Instrument (SCT).

Data Analysis Technique

The research data, consisting of pre-test and post-test scores, underwent prerequisite tests such as normality and homogeneity tests. The paired t-test was then used to analyze whether there were any differences between pre-test and post-test scores. After determining a significant difference in scientific creativity scores, the average level of increase was calculated using the normalized gain (N-gain) method. The scores resulting from the assessment of learning tool validity by three education experts were analyzed using the average to determine validity, and Cronbach's alpha (α) was used to determine the reliability of the learning tools.

RESULTS AND DISCUSSION

Validity Student Activity Sheet

The Student Activity Sheet (SAS) was developed as an educational tool for the Social Sciences Basic Concepts course. To enhance its credibility and efficacy for academic purposes, the SAS underwent a thorough validation process by three expert validators (Chin & Siew, 2015; Dwikoranto et al., 2020). The validation process covered various aspects of the SAS, including didactics, content, presentation, and time, to ensure its alignment with educational standards and practical usability in an educational setting (Liu & Lin, 2014). The detailed results of the SAS validation are presented in Table 1.

The SAS consists of modules that cover the nature and characteristics of Social Sciences, historical development, and foundational concepts. These modules are designed to create an engaging learning environment. This comprehensive approach helps students develop critical thinking and analytical skills, as emphasized by Hesse et al. (2015) and Coderre et al. (2016). By promoting active participation, the SAS plays a crucial role in enhancing student engagement and facilitating a deeper understanding of complex social science concepts. Additionally, the integration of concept maps within the SAS, as discussed by Daley et al. (2016), supports the visual organization of information, which is essential for connecting theoretical concepts with practical applications. This method has proven effective in other disciplines and reinforces the utility of the SAS in promoting an integrative learning approach. The validation process not only confirmed the educational value of the tool but also its adaptability and relevance to the contemporary educational context, aligning with the findings of Bunt et al. (2017). The involvement of multiple validators ensured a comprehensive evaluation from various pedagogical perspectives, thereby enhancing the overall reliability and effectiveness of the tool.

In terms of empirical and theoretical support, the design and implementation of the SAS align with best practices in educational tool development. The focus on active learning and the integration of current pedagogical strategies resonate with Coderre et al.'s (2016) advocacy for tools that engage students as active participants in their learning process. These features are crucial for fostering an environment where students can develop essential skills for analyzing and synthesizing information effectively. Furthermore, considering social capital concepts in educational settings, as explored by Drápala (2020), highlights the SAS's potential to facilitate collaborative learning experiences. This approach is instrumental in building social connections among students, which are vital for creating a supportive educational environment.

The Student Activity Sheet (SAS) for the Basic Social Sciences Concepts course has been validated by expert validators, who have consistently given it high ratings averaging 8.68 and classifying it as "very good" (see Table 1). This demonstrates that the SAS is well-designed and relevant to educational goals (Dwikoranto et al., 2020; Suyidno et al., 2016). The reliability of the SAS as an educational tool is further confirmed by the consistent scores across different validators, aligning with educational research that emphasizes the importance of consistent and reliable assessment methods (Young et al., 2017).

Table 1. SAS Validity Assessment Results

No	Eligibility Components	Score					R (%)	Criteria
		VD 1	VD 2	VD 3	X	C		
Didactics		**8.88**	**8.25**	**9.13**	**8.75**	**SV**	**95**	**Reliable**
1.	According to learning outcomes	9	8	10	9.00	SV	89	Reliable
2.	Continuous flow of material	9	8	10	9.00	SV	89	Reliable
3.	Facilitating students do inquiry	8.5	8.5	8.5	8.50	SV	100	Reliable
4.	Facilitating students to evaluate yourself	9	8.5	8	8.50	SV	94	Reliable
Content		**8.88**	**8.50**	**8.38**	**8.58**	**SV**	**97**	**Reliable**
1.	Complete components	9	9	8	8.67	SV	94	Reliable
2.	Relevant to context everyday life	9	8	8	8.33	SV	94	Reliable
3.	Case examples in accordance with learning objectives	8.5	8.5	8.5	8.50	SV	100	Reliable
4.	The learning achievement test questions are appropriate	9	8.5	9	8.83	SV	97	Reliable
Presentation		**8.70**	**8.80**	**9.00**	**8.83**	**SV**	**100**	**Reliable**
1.	Language according to rules	9	9	9	9.00	SV	94	Reliable
2.	Simple and easy language Understood	8.5	8	9	8.50	SV	100	Reliable
3.	Font type and size Proportional	9	9	9	9.00	SV	100	Reliable
4.	Illustrations/Pictures help Understanding	9	9	9	9.00	SV	100	Reliable
5.	Combination of color good	8	9	9	8.67	SV	94	Reliable
Time		**8.00**	**8.00**	**8.00**	**8.00**	**SV**	**100**	**Reliable**
1.	Time do SAS proportional	8	8	8	8.00	SV	100	Reliable

Note: X = average; VD = validator; R = Reliability; C=Criterion; SV = Very Valid

The validators have provided recommendations for improvements to enhance visual representations, refine content explanations, and simplify language use, all of which align with established principles in educational tool development (Kartini et al., 2019). These suggestions aim to increase the educational effectiveness of the SAS, particularly in improving students' understanding and engagement with the material. This aligns with studies that emphasize the importance of clarity, coherence, and engagement in educational materials for effective learning (Suarez et al., 2022). Additionally, the emphasis on detailed and unambiguous visual representations and coherent explanations of concepts within the SAS addresses key aspects of cognitive load theory, which suggests that reducing unnecessary complexity in learning materials can significantly enhance comprehension and retention of information (Nirfayanti et

al., 2021). By aligning the design and presentation of the SAS with these pedagogical principles, the tool becomes more effective at conveying complex social science concepts in an accessible and engaging manner for students.

The development of the SAS has employed an iterative feedback process, where expert validators continuously provide input to refine the tool. This process exemplifies the application of formative evaluation in educational design, ensuring that the SAS not only meets initial educational objectives but also evolves in response to detailed, expert feedback, maximizing its educational value and relevance (Nirfayanti et al., 2021). The empirical and theoretical support from previous studies confirms the robustness of the SAS's design and validation process, highlighting its potential as a valuable educational resource for teaching social science concepts. The integration of expert feedback into the development process underscores a commitment to quality and efficacy in educational tool development, aligning with best practices for enhancing learning outcomes in the educational sector.

Validity of the Scientific Creativity Test (SCT)

The validation results of the Scientific Creativity Test instrument for supporting research in the Basic Concepts of Social Sciences course, which focuses on indicators such as the creative process, creative person, creative product, and creative environment, are crucial for assessing the effectiveness of the test in measuring scientific creativity (Ayas & Sak, 2014; Dwikoranto et al., 2020) within the context of social sciences education (Nursiwan & Hanri, 2023). The validation process, as presented in Table 2, provides insights into the reliability and validity of the test instrument, offering a comprehensive evaluation of its ability to capture essential aspects of scientific creativity (Nursiwan & Hanri, 2023). The test aims to provide a holistic assessment of students' scientific creativity within the social sciences domain by examining indicators related to the creative process, person, product, and environment.

Table 2. SCT Validity Validation Results

Instruments	Content Validity				Language and Statement			
	Score	Inf.	Koef. R (%)	Inf.	Score	Inf.	Koef. R (%)	Inf.
1. creative process	3.78	SV	90.48	R	3.75	SV	89.29	R
2. creative person	3.89	SV	95.24	R	3.83	SV	92.86	R
3. creative product	3.89	SV	95.24	R	3.83	SV	92.86	R
4. creative environment	3.75	SV	91.07	R	3.75	SV	89.29	R

Note: SV = Very Valid, V = Valid, R = Reliable

The findings from the research on the validation of the Scientific Creativity Test align with existing literature that emphasizes the importance of measuring scientific creativity in educational settings. Other psychometric tools, such as the Creative Scientific Ability Test (C-SAT) and the Test of Scientific Creativity Animations for Children (TOSCAC), have been developed to assess individuals' creative potential, underscoring the need for valid and reliable instruments to evaluate creativity (Lubart et al., 2022). The validation results of the Scientific Creativity Test contribute to this body of knowledge by providing a tailored assessment tool designed specifically for measuring scientific creativity in the context of social sciences education. The validation process of the Scientific Creativity Test incorporates a multidimensional approach to evaluating scientific creativity, considering factors such as the creative process, person, product, and environment. By including diverse indicators in the validation framework, the test aims to capture the complexity of scientific creativity and provide a comprehensive assessment of students' creative abilities within the social sciences discipline (Kaçan & Şahin, 2018). This multifaceted approach enhances the robustness and validity of the test instrument, ensuring that it effectively measures various dimensions of scientific creativity.

Previous research has explored the relationship between scientific creativity and scientific attitudes, highlighting the interconnected nature of creativity and positive dispositions towards science (Nursiwan & Hanri, 2023). Understanding how scientific creativity influences attitudes towards science can provide valuable insights into the role of creativity in fostering engagement, curiosity, and enthusiasm for scientific exploration (Nursiwan & Hanri, 2023). By examining the level of scientific creativity and its impact on attitudes, educators can tailor instructional strategies to enhance students' creative thinking skills and cultivate a positive attitude towards scientific inquiry. The feedback provided by expert validators on the Scientific Creativity Test instrument emphasizes the importance of continuous improvement and refinement in educational assessment tools (Doyan et al., 2020). Suggestions for enhancing the test, such as ensuring clarity in instructions, optimizing item design, and aligning content with learning objectives, aim to improve the validity and reliability of the instrument (Doyan et al., 2020). By incorporating expert recommendations and iteratively refining the test based on feedback, developers can enhance the overall quality and effectiveness of the Scientific Creativity Test for assessing scientific creativity in the Basic Concepts of Social Sciences course.

Effectiveness in Increasing Creativity

Table 3 demonstrates the effectiveness of the Student Activity Sheet (SAS) in enhancing student creativity within the context of art, design, and digital media courses. It shows that all assessed creativity indicators, which were previously incomplete, were fully fulfilled after implementing the SAS. The normalized gain (N-gain) values, falling within the medium criteria range, suggest a moderate improvement in each creativity indicator. This quantifiable increase highlights the role of the SAS in fostering essential creative skills among students.

Table 3. Completeness of Creativity Indicators and N-Gain

Class	Indicator Creativity	Pre test				Post test				*N-Gain*	
		Score	Completeness			Score	Completeness				
			Σ	%	Inf.		Σ	%	Inf.	<g>	Inf.
A	creative process	46.87	8	25.00	TT	78.14	28	87.50	T	0.59	medium
	creative person	40.62	5	15.63	TT	80.46	27	84.38	T	0.67	medium
	creative product	42.96	4	12.50	TT	74.23	25	78.13	T	0.55	medium
	Creative environment	27.32	3	9.38	TT	72.66	26	81.25	T	0.62	medium
B	creative process	44.54	2	6.25	TT	78.91	27	84.38	T	0.62	medium
	creative person	40.63	0	0.00	TT	80.47	28	87.50	T	0.67	medium
	creative product	39.05	2	6.25	TT	75.78	27	84.38	T	0.60	medium
	creative environment	25.00	3	9.38	TT	74.22	28	87.50	T	0.66	medium

Note: T = Completed, TT = Not Completed

The application of the Student Activity Sheet (SAS) aligns with current educational research that emphasizes multimedia-based pedagogy and innovative classroom practices to cultivate creativity in specialized fields like art, design, and digital media (Al Hashimi et al., 2019). The integration of technology and multimedia tools in educational settings is recognized for its potential to enhance creativity and engage students more effectively in learning processes. Studies on creative problem-solving-based learning models further support the effectiveness of SAS, suggesting that such approaches are beneficial in developing creative thinking habits (Fatmawati et al., 2022). These models emphasize problem-solving and active engagement, enabling students to think critically and produce innovative solutions in various contexts.

Moreover, workshops within biomedical science education demonstrate the transformative potential of explicitly teaching creativity, underscoring its broader applicability

across disciplines (Kim et al., 2023). These educational interventions help broaden students' perceptions of creativity, fostering a recognition of its relevance across various academic and professional domains. In the realm of scientific education, the integration of Problem-Based Learning (PBL) with e-authentic assessment has proven effective in enhancing scientific creativity, particularly in courses like static fluid (Irma et al., 2023). These findings highlight the positive impact of active learning and collaborative projects on students' creativity and problem-solving skills.

However, contrasting studies exploring the use of breakout room discussions in online learning environments reveal mixed results regarding their effectiveness in promoting creativity and engaging students (Amelia & Yosintha, 2022). These mixed outcomes highlight the complexity and contextual sensitivity of instructional strategies aimed at enhancing creativity, indicating the need for further research to better understand the variables influencing educational impacts on creativity in diverse learning settings.

Table 4 presents the results from paired t-tests conducted in Class A and Class B, showing t scores of -32.3 and -30.6, respectively, with degrees of freedom (df) of 31 for both classes. The significance values reported are less than 0.05, indicating a statistically significant increase in creativity levels in both classes after the implementation of the Student Activity Sheet (SAS). These results clearly demonstrate the effectiveness of SAS in enhancing student creativity as part of the curriculum.

Table 4. Paired t-test results

N	Paired t-test				
	Mean	***Std. Deviation***	***t***	***df***	***P***
32	-72.6	12.8	-32.3	31	0.00
32	-67.9	15.2	-30.6	31	0.00

Note: *p < 0,05 (*two-tailed*)

The findings from Table 4 support the research conducted by Smyrnaiou et al. (2020), which emphasizes the effectiveness of the SAS in enhancing students' creativity. The significant increase in creativity, as indicated by the negative t scores and low p-values, confirms the positive impact of the SAS on students' creative capabilities. This improvement can be attributed to the innovative and engaging activities included in the SAS, which are designed to stimulate creative thinking and problem-solving skills. Similar positive outcomes in fostering creativity have been demonstrated by Siew and Ambo (2018) through project-based and STEM-oriented educational approaches. Their research with fifth graders suggests that structured, inquiry-based learning environments significantly contribute to enhancing students' creative and analytical skills. These results support the effectiveness of incorporating project-based learning and STEM education to stimulate creativity and critical thinking.

However, contrasting outcomes were reported by Tran et al. (2021), who examined the impact of a STEAM-based curriculum on elementary students' scientific creativity. Despite finding significant improvements, their methodology and interventions provide a different perspective on how educational strategies may influence creativity differently depending on contextual factors. This discrepancy highlights the complex dynamics of educational interventions and the need to consider varied approaches to effectively foster creativity. Furthermore, literature from Lubart et al. (2022) and Chin and Siew (2015) emphasizes the importance of using psychometric tools and validated assessments to measure and develop creativity within educational settings. These tools can provide educators with the necessary data to tailor instructional strategies that effectively enhance creative thinking and problem-solving abilities among students. Such methods contribute to a more systematic approach to nurturing creativity, ensuring that educational practices are evidence-based and conducive to promoting intellectual growth.

Table 5 demonstrates that the implementation of the Student Activity Sheet (SAS) in classes A and B successfully improved the completeness of creativity indicators. Previously incomplete indicators showed substantial improvement after the implementation of the SAS. The N-gain values, falling within the medium criteria range, further support the level of enhancement in each creativity indicator.

Table 5. Completeness of Creativity Indicators

Class	Indicator	Pre-test				Post-test				*N-Gain*	
		Score	Completeness			Score	Completeness				
			Σ	%	Inf.		Σ	%	Inf.	<g>	Inf.
A	Fluency	56.64	11	34.38	TT	76.69	28	87.50	T	0.46	Medium
	Flexibility	53.13	5	15.63	TT	73.83	27	84.38	T	0.44	Medium
	Originality	41.54	2	6.25	TT	66.80	26	81.25	T	0.43	Medium
	Elaboration	41.44	2	6.27	TT	66.81	26	81.30	T	0.43	Medium
B	Fluency	51.82	10	31.25	TT	73.05	28	87.50	T	0.44	Medium
	Flexibility	51.30	6	18.75	TT	70.57	27	84.38	T	0.40	Medium
	Originality	46.22	3	9.38	TT	68.36	26	81.25	T	0.41	Medium
	Elaboration	46.08	3	9.36	TT	68.40	26	81.30	T	0.43	Medium

Note: T = Completed, TT = Not Completed

The findings in Table 5 reflect broader educational research that emphasizes the effectiveness of targeted instructional tools like the SAS in promoting creativity among students. The improvement in creativity indicators confirms the SAS's role in encouraging creative thinking through structured educational activities and learning experiences. Supporting these observations, a study by Saregar et al. (2021) on the CORE learning model further emphasizes the value of innovative teaching approaches in enhancing creative thinking. These findings highlight the importance of implementing specific learning models that foster creative skills in students. By adopting proven methods like the CORE model, educators can effectively promote creativity and critical thinking, which are essential for academic success. On the other hand, Xue et al.'s (2020) research on the impact of extrinsic motivation on creativity presents a more nuanced picture. While it also reports significant improvements in creativity, it emphasizes the diverse effects that different motivational factors can have on creative outcomes. This contrast underscores the complex relationship between instructional methods, motivational influences, and creativity, suggesting that the impact may vary depending on contextual and individual factors.

Collectively, these studies indicate that while the SAS is effective in enhancing creativity, a comprehensive approach is needed in the broader field of creativity in education. Research supports the use of validated tools and methodologies to systematically measure and develop creativity. Employing evidence-based practices enables educators to personalize their teaching strategies to better nurture creativity and critical thinking, ultimately enhancing overall student development and academic performance.

CONCLUSION

The Basic Social Sciences Concepts course utilizes learning tools, including the Student Activity Sheet (SAS) and the Scientific Creativity Test (SCT), to enhance the scientific creativity of Open University primary teacher education (PGSD) students. These tools meet valid criteria and are effectively integrated into the lectures.

RECOMMENDATION

The developed SAS can be utilized to promote student creativity. To achieve optimal results, it is recommended that the steps on the chosen platform be implemented more rigorously. This model prioritizes students' products while maintaining moderate control over

the work process. Creating a learning environment that ensures students' work is their own is crucial.

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REFERENCES

Akcanca, N., & Ozsevgec, L. C. (2017). Effect of Activities Prepared by Different Teaching Techniques on Scientific Creativity Levels of Prospective Pre-school Teachers. *European Journal of Educational Research, volume–7–2018*(volume7-issue1.html), 71–86. https://doi.org/10.12973/eu-jer.7.1.71

Al Hashimi, S. A., Al Muwali, A. A., Zaki, Y. E., & Mahdi, N. A. (2019). The Effectiveness of Social Media and Multimedia-Based Pedagogy in Enhancing Creativity among Art, Design, and Digital Media Students. *International Journal of Emerging Technologies in Learning (iJET)*, *14*(21), 176. https://doi.org/10.3991/ijet.v14i21.10596

Amelia, H., & Yosintha, R. (2022). The Use of Breakout Rooms Discussion in JIGSAW Online Learning Class: Developing Creativity and Increasing Student Engagement. *ELTR Journal*, *6*(2), 86–95. https://doi.org/10.37147/eltr.v6i2.149

Ayas, M. B., & Sak, U. (2014). Objective measure of scientific creativity: Psychometric validity of the Creative Scientific Ability Test. *Thinking Skills and Creativity*, *13*, 195–205. https://doi.org/10.1016/j.tsc.2014.06.001

Bunt, S., Steverink, N., Olthof, J., Van Der Schans, C. P., & Hobbelen, J. S. M. (2017). Social frailty in older adults: A scoping review. *European Journal of Ageing*, *14*(3), 323–334. https://doi.org/10.1007/s10433-017-0414-7

Büyük, U., & Koç, A. (2020). Effect of Robotics Technology in Science Education onScientific Creativity and Attitude Development. *Turkish Journal of Science Education*, *18*(1), 54–72. https://doi.org/10.36681/tused.2021.52

Chan, S., & Yuen, M. (2015). Teachers' beliefs and practices for nurturing creativity in students: Perspectives from teachers of gifted students in Hong Kong. *Gifted Education International*, *31*(3), 200–213. https://doi.org/10.1177/0261429413511884

Chin, M. K., & Siew, N. M. (2015). The Development and Validation of a Figural Scientific Creativity Test for Preschool Pupils. *Creative Education*, *06*(12), 1391–1402. https://doi.org/10.4236/ce.2015.612139

Coderre, R. W., Uekermann, K. A., Choi, Y., & Anderson, W. J. (2016). Creating Critical Consumers of Health and Science News: Teaching Science to the Non-Scientist Using Newsworthy Topics in the Life Sciences. *Journal of Microbiology & Biology Education*, *17*(1), 107–109. https://doi.org/10.1128/jmbe.v17i1.1023

Daley, B. J., Durning, S. J., & Torre, D. M. (2016). Using Concept Maps to Create Meaningful Learning in Medical Education. *MedEdPublish*, *5*, 19. https://doi.org/10.15694/mep.2016.000019

Diep, N. H., Thuy, H. T. P., Lai, D. T. B., Viet, V. V., & Chung, N. T. K. (2023). A comparison of three stem approaches to the teaching and learning of science topics: Students' knowledge and scientific creativity. *International Journal of Education and Practice*, *11*(2), 266–278. https://doi.org/10.18488/61.v11i2.3336

Djati, S. P., Sudjana, I. M., Darsana, I. M., Sudiarta, I. N., & Mahendra, I. W. E. (2022). The Impact Of Certified Competency Tourism Human Resources In Facing The Aec Era: Case Study In Bali. *TRJ Tourism Research Journal*, *6*(2), 207. https://doi.org/10.30647/trj.v6i2.152

Doyan, A., Susilawati, S., & Hardiyansyah, H. (2020). Development of Natural Science Learning Tools with Guided Inquiry Model Assisted by Real Media to Improve Students' Scientific Creativity and Science Process Skills. *Jurnal Penelitian Pendidikan IPA*, *7*(1), 15–20. https://doi.org/10.29303/jppipa.v7i1.485

Drápala, D. (2020). Social Capital and Safeguarding of Intangible Cultural Heritage: Theoretical Concepts of Departure and the Potential of Further Research. *Slovenský Národopis / Slovak Ethnology*, *68*(2), 122–135. https://doi.org/10.2478/se-2020-0007

Dwikoranto, Setiani, R., Widuroyekti, B., Tresnaningsih, S., Sambada, D., Setyowati, T., Rohman, A., & Harnoto, B. T. (2020). The Effectiveness of the Student Activity Sheet (SAS) on Teaching-Learning and Creativity (TLC) Model to Increase Creativity Competence. *Studies in Learning and Teaching*, *1*(3), 175–184. https://doi.org/10.46627/silet.v1i3.36

Fatmawati, B., Jannah, B. M., & Sasmita, M. (2022). Students' Creative Thinking Ability Through Creative Problem Solving based Learning. *Jurnal Penelitian Pendidikan IPA*, *8*(4), 2384–2388. https://doi.org/10.29303/jppipa.v8i4.1846

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2012). *How to design and evaluate research in education* (8th ed). McGraw-Hill Humanities/Social Sciences/Languages.

Genek, S. E., & Küçük, Z. D. (2020). Investigation of scientific creativity levels of elementary school students who enrolled in a STEM program. *İlköğretim Online*, 1715–1728. https://doi.org/10.17051/ilkonline.2020.734849

Harvey, M. W., Yssel, N., Bauserman, A. D., & Merbler, J. B. (2010). Preservice Teacher Preparation for Inclusion: An Exploration of Higher Education Teacher-Training Institutions. *Remedial and Special Education*, *31*(1), 24–33. https://doi.org/10.1177/0741932508324397

Hesse, B. W., Moser, R. P., & Riley, W. T. (2015). From Big Data to Knowledge in the Social Sciences. *The ANNALS of the American Academy of Political and Social Science*, *659*(1), 16–32. https://doi.org/10.1177/0002716215570007

Irma, Z. U., Kusairi, S., & Yuliati, L. (2023). STREM PBL with E-Authentic Assessment: Its Impact to Students' Scientific Creativity on Static Fluid. *Jurnal Pendidikan IPA Indonesia*, *12*(1), 80–95. https://doi.org/10.15294/jpii.v12i1.40214

Jatmiko, B., Prahani, B. K., Munasir, M., Imam Supardi, Z. A., Wicaksono, I., Erlina, N., Pandiangan, P., Althaf, R., & Zainuddin, Z. (2018). The comparison of OR-IPA teaching model and problem based learning model effectiveness to improve critical thinking skills of pre-service physics teachers. *Journal of Baltic Science Education*, *17*(2), 300–319. https://doi.org/10.33225/jbse/18.17.300

Kaçan, S. D., & Şahin, F. (2018). The Impact of Scientific Creative Thinking Skills on Scientific Process Skills. *SHS Web of Conferences*, *48*, 01060. https://doi.org/10.1051/shsconf/20184801060

Kartini, K., Doyan, A., Kosim, K., Susilawati, S., Khasanah, B. U., Hakim, S., & Muliyadi, L. (2019). Analysis of Validation Development Learning Model Attainment Concept to Improve Critical Thinking Skills and Student Learning Outcomes. *Jurnal Penelitian Pendidikan IPA*, *5*(2), 185–188. https://doi.org/10.29303/jppipa.v5i2.262

Kim, A. M., Gibbons, J. A., Speed, C. J., & Macaulay, J. O. (2023). Making creativity explicit: A workshop to foster creativity in biomedical science education. *Biochemistry and Molecular Biology Education*, *51*(6), 644–652. https://doi.org/10.1002/bmb.21776

Liu, S.-C., & Lin, H. (2014). Primary Teachers' beliefs about Scientific Creativity in the Classroom Context. *International Journal of Science Education*, *36*(10), 1551–1567. https://doi.org/10.1080/09500693.2013.868619

Lubart, T., Kharkhurin, A. V., Corazza, G. E., Besançon, M., Yagolkovskiy, S. R., & Sak, U. (2022). Creative Potential in Science: Conceptual and Measurement Issues. *Frontiers in Psychology*, *13*, 750224. https://doi.org/10.3389/fpsyg.2022.750224

Mercan, G., & Köseoğlu, P. (2022). Examining the Scientific Creativity of Biology Teacher Candidates According to their Problem-Solving Skills. *Batı Anadolu Eğitim Bilimleri Dergisi*, *13*(2), 1423–1439. https://doi.org/10.51460/baebd.1064850

Nacaroğlu, O., & Mutlu, F. (2023). Investigating Lifelong Learning Tendencies and Scientific Creativity Levels of Prospective Science Teachers. *Acta Educationis Generalis*, *13*(1), 74–95. https://doi.org/10.2478/atd-2023-0004

Nieveen, N., & Folmer, E. (2013). Formative Evaluation in Educational Design Research. In T. Plomp & N. Nieveen (Eds.), *Educational Design Research* (pp. 152–169). SLO.

Nieveen, N. M., van den Akker, J. J. H., & Voogt, J. M. (2023). Curriculum design. In R. J. Tierney, F. Rizvi, & K. Ercikan (Eds.), *International Encyclopedia of Education (Fourth Edition)* (pp. 198–205). Elsevier. https://doi.org/10.1016/B978-0-12-818630-5.03032-3

Nirfayanti, Nurwijaya, S., Djafar, S., Ramdani, R., Padang, N. S., & Ernawati. (2021). *Development of Discrete Mathematics Learning Content Using Google Classroom in Mathematics Education Students*. 276–281. https://doi.org/10.2991/assehr.k.210508.075

Nursiwan, W. A., & Hanri, C. (2023). Relationship between level of scientific creativity and scientific attitudes among prospective chemistry teachers. *International Journal of Evaluation and Research in Education (IJERE)*, *12*(1), Article 1. https://doi.org/10.11591/ijere.v12i1.22852

Pangastuti, R., & Fadhillah, N. (2020). Integrated Twin Tower (ITT) Based Learning to Think (LTT) Model to Enhance Scientific Creativity and Spiritual of students in the Early Childhood Islamic Education Department. *Studies in Learning and Teaching*, *1*(1), Article 1. https://doi.org/10.46627/silet.v1i1.21

Prahani, B. K., Suprapto, N., Suliyanah, Lestari, N. A., Jauhariyah, M. N. R., Admoko, S., & Wahyuni, S. (2018). The effectiveness of collaborative problem based physics learning (CPBPL) model to improve student's self-confidence on physics learning. *Journal of Physics: Conference Series*, *997*, 012008. https://doi.org/10.1088/1742-6596/997/1/012008

Saregar, A., Cahyanti, U. N., Misbah, M., Susilowati, N. E., Anugrah, A., & Muhammad, N. (2021). CORE learning model: Its effectiveness towards students' creative thinking. *International Journal of Evaluation and Research in Education (IJERE)*, *10*(1), Article 1. https://doi.org/10.11591/ijere.v10i1.20813

Siew, N. M., & Ambo, N. (2018). Development and Evaluation of an Integrated Project-Based and STEM Teaching and Learning Module on Enhancing Scientific Creativity among Fifth Graders. *Journal of Baltic Science Education*, *17*(6), 1017–1033. https://doi.org/10.33225/jbse/18.17.1017

Smyrnaiou, Z., Georgakopoulou, E., & Sotiriou, S. (2020). Promoting a mixed-design model of scientific creativity through digital storytelling—The CCQ model for creativity. *International Journal of STEM Education*, *7*(1), 25. https://doi.org/10.1186/s40594-020-00223-6

Suarez, A. D., Rabago, J. K. M., & Paguyo, C. G. (2022). Identifying the Extent of Need in the Different Concepts under Disciplines and Ideas in Social Sciences: A Basis in Developing Mobile Based e-Learning Application. *Asian Research Journal of Arts & Social Sciences*, 135–150. https://doi.org/10.9734/arjass/2022/v18i4411

Suyidno, S., Nur, M., & Yuanita, L. (2016). Developing Worksheets Based On Scientific Creativity in Fundamental Physics Course. *Proceeding International Seminar on Science Education (ISSE) Graduate School Yogyakarta State University*, 442–449.

Suyidno, S., Nur, M., Yuanita, L., Prahani, B. K., & Jatmiko, B. (2018). Effectiveness of creative responsibility based teaching (CRBT) model on basic physics learning to increase student's scientific creativity and responsibility. *Journal of Baltic Science Education*, *17*(1), 136–151. https://doi.org/10.33225/jbse/18.17.136

Tran, N.-H., Huang, C.-F., Hsiao, K.-H., Lin, K.-L., & Hung, J.-F. (2021). Investigation on the Influences of STEAM-Based Curriculum on Scientific Creativity of Elementary School Students. *Frontiers in Education*, *6*. https://doi.org/10.3389/feduc.2021.694516

Xue, Y., Gu, C., Wu, J., Dai, D. Y., Mu, X., & Zhou, Z. (2020). The Effects of Extrinsic Motivation on Scientific and Artistic Creativity among Middle School Students. *The Journal of Creative Behavior*, *54*(1), 37–50. https://doi.org/10.1002/jocb.239

Young, S. D., Yu, W., & Wang, W. (2017). Toward Automating HIV Identification: Machine Learning for Rapid Identification of HIV-Related Social Media Data. *JAIDS Journal of Acquired Immune Deficiency Syndromes*, *74*, S128. https://doi.org/10.1097/QAI.0000000000001240

Zulkarnaen, Z., Supardi, Z. A. I., & Jatmiko, B. (2017). Feasibility of Creative Exploration, Creative Elaboration, Creative Modeling, Practice Scientific Creativity, Discussion, Reflection (C3PDR) Teaching Model to Improve Students' Scientific Creativity of Junior High School. *Journal of Baltic Science Education*, *16*(6), 1020–1034. https://doi.org/10.33225/jbse/17.16.1020