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Improving Creative Thinking Problem Solving and Communication Skills of Prospective Teachers through Ethnoscience Learning in a Basic Science Concepts Course

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ABSTRACT

The primary issue identified in this study pertained to the suboptimal enhancement of several proficiencies, including creative thinking, problem-solving, and communication abilities, among aspiring educators. The primary objective of this research was to provide a comprehensive description and analysis of the efficacy of ethnoscience learning in enhancing the cognitive abilities of aspiring educators, specifically in the domains of creative thinking, problem-solving, and communication skills. The research design encompassed three distinct steps, specifically: 1) the collection of qualitative data, 2) the implementation of treatments, and 3) the undertaking of post-intervention qualitative investigations. A total of 120 preservice teachers in their third semester of elementary school were chosen as the sample for this study. The data was obtained by means of surveys, observations, interviews, essay examinations designed to assess creative thinking and problem-solving abilities, and observation sheets used to evaluate communication skills. The quantitative data were subjected to statistical analysis using an independent t-test and analysis of variance (ANOVA). The utilisation of ethnoscience learning has demonstrated its efficacy in enhancing cognitive abilities such as creative thinking, problem-solving, and communication skills.

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1. INTRODUCTION

Higher education, as one of the institutions educating prospective teachers, should facilitate learning that trains and develops their creativity (Daud et al., 2012). However, creative thinking skills are not optimally equipped for them. Prospective teachers had a low level of creativity and they had a lack of understanding of creativity dimensions (Newton, 2009). The result of another study conducted in Indonesia showed that the creative thinking skills of prospective teachers tended to be low. The understanding of creative thinking skills of prospective elementary school teacher students was still low (Fatmawati, 2011; Julianto et al., 2018). Teachers did not develop students' creative thinking skills in learning (Ermasari et al., 2014; Fauziyah, 2011). Teachers having creative thinking skills were related to

the effectiveness of the learning they applied (Davidovitch & Milgram, 2010); it had an impact on the achievement of students' creative thinking (Hosseini & Watt, 2010). Conversely, teachers having low creativity did not develop students' creative thinking skills (Al-Abdali et al., 2014), they did not understand the dimensions of creativity (Newton, 2009).

Developing and training problem-solving thinking skills are deemed crucial for individuals aspiring to become scientific teachers, as highlighted by Nurita et al. (2017). The aforementioned abilities were employed as a means for individuals to effectively engage in competition, exercise sound judgement, demonstrate caution, employ systematic approaches, apply logical reasoning, and analyse situations from multiple angles (Adeyemo et al., 2013). Kennedy et al. (2016) emphasised the significance of problem-solving abilities in the field of education. They asserted that educators require fundamental skills, and among them, the possession of problem-solving skills by potential teachers is considered a crucial component for facilitating effective learning. A teacher with good problem-solving thinking skills could carry out effective learning and improve learning outcomes (Adeyemo et al., 2013), train students to construct their knowledge and to take a role in knowledge acquisition (Karatas & Baki, 2013). The research results that measure prospective teachers' problem-solving skills are still in the low category were conducted by Busyairi & Sinaga (2015) and Purwandari (2018). The low ability to solve problems was caused by a lack of knowledge, motivation and understanding of emotional aspects (Dostal, 2015). In addition, the learning model greatly influences problem-solving skills (Davis et al., 2018).

Communication skills are essential for working in the 21st century (Savendra & Opfer, 2012). Effective learning and achievement of student learning outcomes are influenced by the teacher's communication skills (Akpinar et al., 2009; Ekici, 2010). The teacher, as the initiator of effective communication in the classroom, should have good communication skills. The communication carried out by the teacher had an impact on increasing students' understanding of concepts (Khan et al., 2017) ; increasing their motivation (Doménech-betoret et al., 2014); the ability to listen for explanations (Bray et al., 2012); including their self-confidence (Erİgüç et al., 2013). Based on the existing problems, a learning program is needed that can facilitate the improvement of those skills for prospective teachers. How is the learning program that can improve creative thinking, problem-solving, and communication skills?

According to previous studies on ethnoscience learning, it has been found that this approach facilitates students' comprehension of science concepts (Suastra, 2010; Sudarmin, 2014). It also promotes students' appreciation for their cultural heritage (Novia et al., 2015) and fosters a sense of strong nationalism (Atmojo, 2012). Moreover, ethnoscience learning is oriented towards effective pedagogy as it enhances students' assimilation and accommodation processes (Supriyadi et al., 2016), improves their mastery of concepts and generic science skills, and enhances their literacy (Sumarni, 2018). Furthermore, this approach cultivates problem-solving abilities (Novia et al., 2015; Supriyadi et al., 2016), encourages active learning (Rahmawati & Nizam, 2018), and develops critical thinking skills (Arfianawati, 2016). The primary objective of this study is to assess the effects of ethnoscience education on the development of creative thinking, problem-solving abilities, and communication skills among those aspiring to become teachers. The findings of this study have the potential to make significant contributions to the advancement of scientific knowledge in the domain of ethnoscience.

2. METHODS

This research used quantitative and qualitative methods, known as mixed methods. The research design used was an experimental/intervention design. This research design consists of three stages, namely: 1) qualitative study as a basis for conducting experimental studies, 2) conducting experimental studies, and 3) determining how qualitative findings improve experimental results (Creswell & Clark, 2018). In this research phase, the experimental design used was the Solomon Four Group Design. The experimental design is presented in Table 1.

Table 1. Solomon Four Group Design Experiment Plan

Class	Pretest	Treatment	Posttest
Groups Experiment I	Q_1	X	Q_2
Control Grup I	Q_3	-	Q_4
Groups Experiment II	-	X	Q_5
Control Group II	-	-	Q_6

Source: Sugiyono (2010)

X = ethnoscience treatment learning

Q1,Q3 = pretest for experiment or control group

Q2,Q4,Q5,Q6 = post-test for experiment or control group

The subjects of this study were 120 elementary school teacher candidates. The use of purposive sampling is based on the similarity of names and achievements in basic science concepts courses. Data measurement techniques were used to observe the implementation of the basic science concept learning program. In addition, this technique was used to obtain data on communication skills. This interview was used to obtain data on the problems of learning the basic concepts of science. The tests were used to obtain data on creative thinking skills and problem-solving skills. The difficulty parameter of all items in the test instrument ranged from -0.85 to 0.47. Parameters met the good criteria based on Hamblehaton & Swaminathan (1985) because the item difficulty index was still around $-2 < b < 2$. The value of internal consistency (reliability) of the items was 0.77, which had high reliability.

3. FINDINGS AND DISCUSSION

3.1 Problem-Solving Skills

Data on problem-solving skills for each dimension of each group is presented in Figure 1.

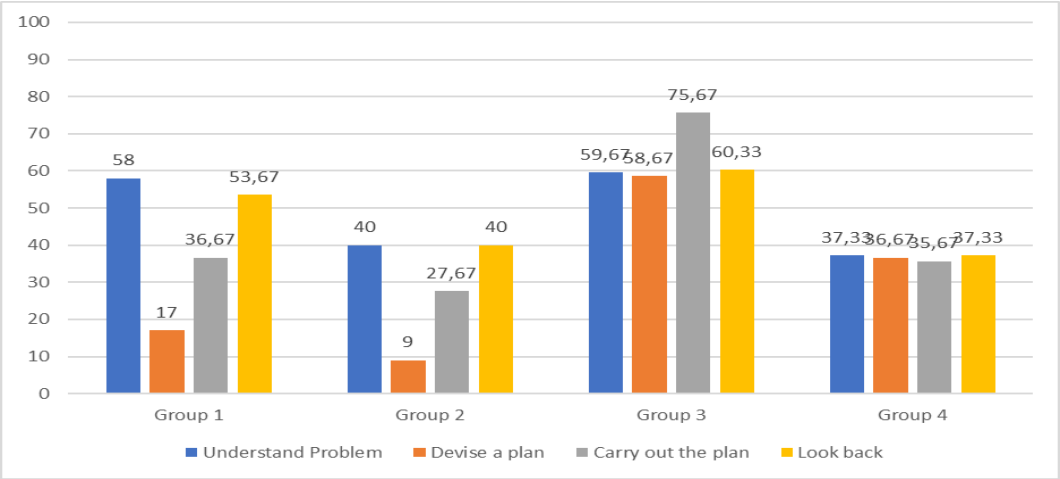

Figure 1. Problem-Solving Skills

The gain scores were obtained from the acquisition of pretest and posttest data for the experimental group I and the control group I. Gain scores for problem-solving skills are presented in Table 2.

Table 2. Gain Score of Problem Solving

Variable	Group	Average pretest	Average posttest	Average Gain score	Criteria
Problem solving	Group 1	14,6	29,8	0,30	Medium
	Group 2	18,4	25,8	0,17	Low

One Way Anova test was applied to determine differences in problem-solving skills between groups. The results of the one-way ANOVA test are presented in Table 3.

Table 3. One Way Anova Test of Problem Solving Skills

F Value	Significant Value	Explanation
59.956	.000	There was difference

The further test used was LSD (Least Significance Different). The LSD test was carried out to find out in more detail which groups were different and which were not different. LSD test results are presented in Table 4.

Table 4. Post Hoc Test Data of Communication Skills

Post Hoc Test	Significant Value	Explanation
Group 1 and Group 2	.000	real difference
Group 1 and Group 3	.007	no real difference
Group 1 and Group 4	.000	real difference
Group 2 and Group 1	.000	real difference
Group 2 and Group 3	.000	real difference
Group 2 and Group 4	.313	no real difference
Group 3 and Group 1	.007	no real difference
Group 3 and Group 2	.000	real difference
Group 3 and Group 4	.000	real difference
Group 4 and Group 1	.000	real difference
Group 4 and Group 2	.313	no real difference
Group 4 and Group 3	.000	real difference

3.2 Creative Thinking Skills

The results of the analysis of creative thinking skills for each dimension of each group are presented in Figure 2.

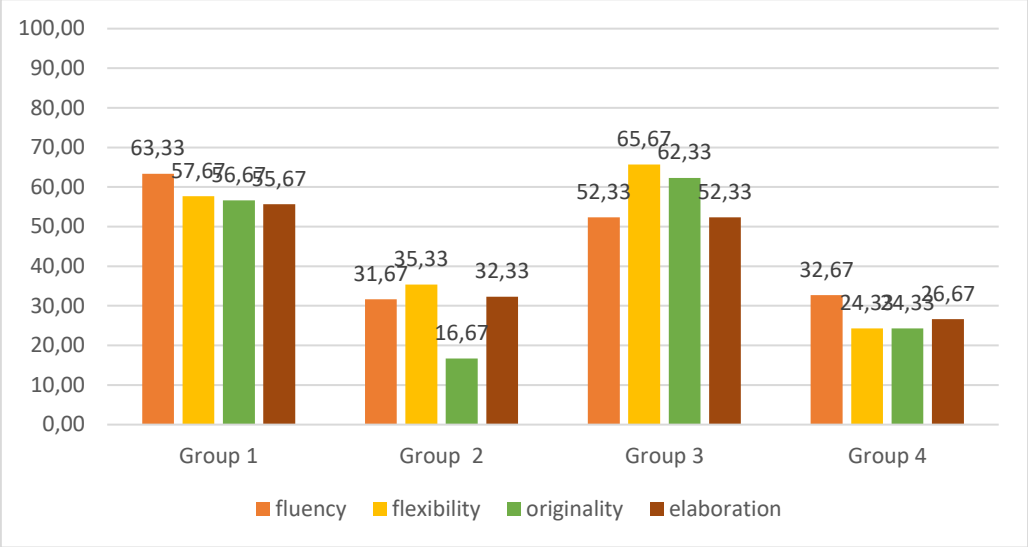

Figure 2. Creative Thinking Skills

The gain score was obtained from the acquisition of pretest and posttest data for the experimental group I and the control group I. The gain score for creative thinking skills is presented in Table 5.

Table 5. Gain Score

Variable	Group	Pretest mean	Average posttest	Average Gain score	Criteria
Creative Thinking	Group 1	1.33	6,37	0.30	Currently
	Group 2	1.36	2,26	0.06	Low

One way Anova test to find out there are differences in creative thinking skills between groups. The results of the One way ANOVA test are presented in Table 6.

One Way Anova Test Data on Creative Thinking Skills

Table 6. *One Way Anova* Test Data on Creative Thinking Skills

F grade	Significant Value	Information
133,831	.000	There is a difference

The further test used is LSD (Least Significance Different). The LSD test was carried out to find out in more detail which groups were different and which were not different. The LSD test results are presented in Table 7.

Table 7. Post Hoc Test of Creative Thinking Skills

Post hoc test	Significant Value	Information
Group 1 with Group 2	.000	Real different
Group 1 with Group 3	1,000	Not really different
Group 1 with Group 4	.000	Real different
Group 2 with Group 1	.000	Real different
Group 2 with Group 3	.000	Real different
Group 2 with Group 4	.793	Not really different

Group 3 with Group 1	1,000	Not really different
Group 3 with Group 2	.000	Real different
Group 3 with Group 4	.000	Real different
Group 4 with Group 1	.000	Real different
Group 4 with Group 2	.793	Not really different
Group 4 with Group 3	.000	Real different

The incorporation of ethnoscience learning has been found to enhance the development of creative thinking skills among aspiring educators. The observed rise in pretest and posttest scores, namely within the "medium" category, among participants in the experimental group suggests a discernible impact of the learning programme. This study involves engaging in learning activities centred around the challenges faced by prawn paste crafters, smoked fish producers, and milkfish farmers. These activities include assessing the problems encountered by these individuals and performing thorough research to identify potential solutions. The study found that the average acquisition of the four markers of creative thinking did not reach its optimum potential, as it fell below a score of 65 out of a possible range of 100. Based on the findings of Wasis (2016) and Riyadi et al. (2017), it has been observed that students exhibit a tendency to successfully solve problems that they have encountered frequently or are familiar with, commonly referred to as routine problems. However, they encounter difficulties when confronted with unfamiliar or non-routine problems. Consequently, students rely on memorization to solve routine problems, while they struggle with reasoning and problem-solving skills when faced with more challenging problems. The process of learning poses challenges that involve non-routine difficulties, which serve as a means to prepare aspiring educators in generating original ideas and cultivating innovative thinking (Ulger, 2018).

3.3 Communication Skills

Communication skill data for each dimension of each group is presented in Figure 3.

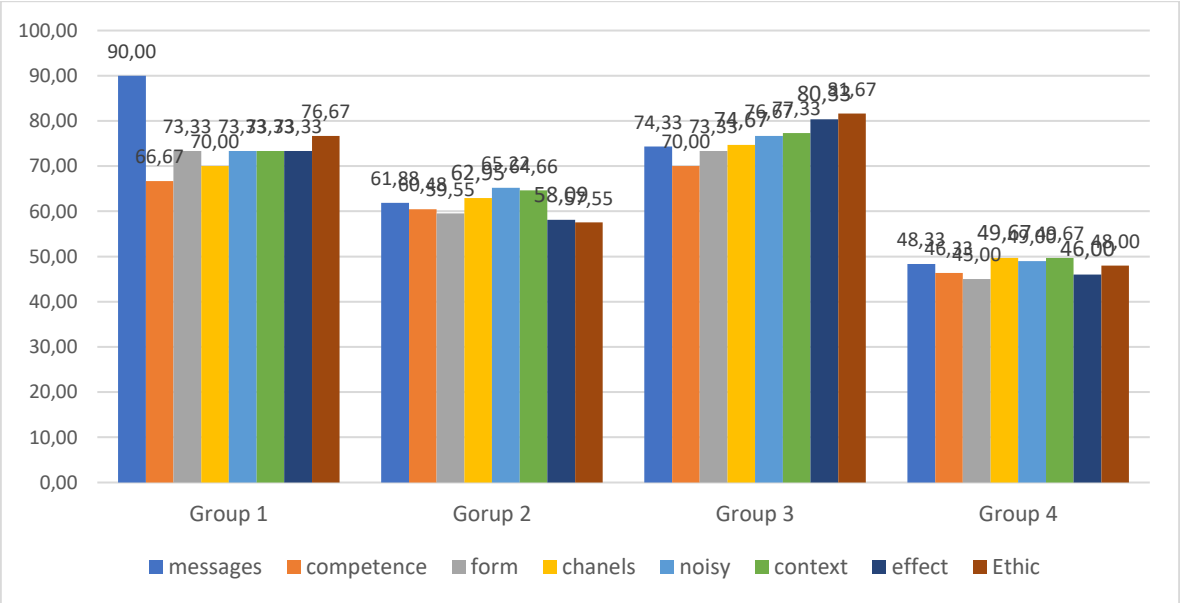

Figure 3. Communication Skills

One way Anova test to find out there are differences in communication skills between groups. The results of the oneway ANOVA test are presented in Table 8.

Table 8. One-Way Anova Test Data Communication Skills

F grade	Significant Value	Information
195,312	.000	There is a difference

The LSD test was carried out to find out in more detail which groups were different and which were not different. LSD test results are presented in Table 9.

Table 9. Post hoc Test of Communication Skills Data

Post hoc test	Significant Value	Information
Group 1 with Group 2	.000	Real different
Group 1 with Group 3	007	Not really different
Group 1 with Group 4	.000	Real different
Group 2 with Group 1	.000	Real different
Group 2 with Group 3	.000	Real different
Group 2 with Group 4	.313	Not really different
Group 3 with Group 1	007	Not really different
Group 3 with Group 2	.000	Real different
Group 3 with Group 4	.000	Real different
Group 4 with Group 1	.000	Real different
Group 4 with Group 2	.313	Not really different
Group 4 with Group 3	.000	Real different

Ethnoscience learning can improve communication skills. Eight student communication indicators with a greater score ≥ 65 for the experimental class. This score indicates that the seven indicators of communication skills are above average but not yet optimal. Improved communication skills develop from learning activities to present problems, carry out investigations, and compile investigative reports, discussions and presentations, which are learning activities. Investigative learning activities, compiling reports, discussions and presentations train students to have good communication skills. To train students' communication skills, lecturers/teachers must provide oral discussions and presentations, investigative activities that involve writing reports (Joseph, 2010; Noviyanti, 2011) , presenting science exhibitions, and presenting science with local culture. This learning program connects the culture of the surrounding community and is studied in learning so as to support contextual learning for prospective teachers, thereby making science more relevant to students in culturally diverse classrooms (Beer et al., 2022). Indigenous and Western modern science culture may complement each other in students' everyday experience, thereby making science more relevant to students in culturally diverse classrooms (Beer et al., 2022). The ethnoscience approach helps students to maintain the wisdom values of their local culture (Ngasike, 2011 ; Perin, 2011)**.**

4. CONCLUSION

There was an increase in prospective teachers' creative thinking, problem solving, and communication skills after participating in ethnoscience learning in the basic science concepts course. In addition, there was a difference between the experimental and control groups with a significance value of <0.05. The limitation of this research is that learning was carried out during the COVID-19 pandemic. The potential for future research is to design blended learning learning so that it can be carried out in various situations.

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REFERENCES

Adeyemo, S. A., Babajide, V. F. T., & & Amusa, J. O. (2013). The Relationship among Teachers ' Problem Solving Abilities , Students ' Learning Styles and Students ' Academic Achievement in physics. 7(4), 654–660.

Ahmetoglu, E., & Acar, I. H. (2016). The Correlates of Turkish Preschool Preservice Teachers ' Social Competence , Emp athy and Communication Skills. https://doi.org/10.13187/ejced..16.188

Akpinar, E., Yildiz, E., Tatar, N., & Ergin, O. (2009). Gender , grade level , and academic achievement World Conference on Educational Sciences 2009 Students ' attitudes toward science and technology : an investigation of gender , grade level , and academic achievement. Procedia Social and Behavioral Science, 2804–2808. https://doi.org/10.1016/j.sbspro.2009.01.498

Aküzüm, C., & Gültekin, S. Ö. (2017). Sınıf öğretmenlerinin iletişim becerileri ile sınıf yönetimi becerileri arasındaki ilişkinin incelenmesi. [Examining the relationship between primary school teachers' communication skills and classroom management skills]. Electronic Journal of Education Sciences, 6(12), 88–107.

Al-Abdali, N., Sulaiman, & Balush. (2014). Teaching for Creativity by Science Teachers in Grades 5-10. International Journal of Science and Mathematics Education, 14, 251–268.

Alexander, K. I. M. D., Ed, M., Baker, M., & Shinn, G. (2007). Effects Instruction in Creative Problem Solving on Cognition, Creativity, and Satisfaction among Ninth Grade Students in an Introduction to World Agricultural Science and Technology Course. Faculty of Texas Tech University.

Ardichvili, A., Cardozo, R., & Ray, S. (2003). A theory of entrepreneurial opportunity identification and development. 18, 105–123.

Arfianawati, S. (2016). MODEL PEMBELAJARAN KIMIA BERBASIS ETNOSAINS UNTUK MENINGKATKAN KEMAMPUAN BERPIKIR KRITIS SISWA. 46–51.

Atmojo, S. E. (2012). Profil Keterampilan Proses Sains dan Apresiasi Siswa Terhadap Profesi Pengrajin Tempe Dalam Pembelajaran IPA Berpendekatan Etnosains. Jurnal Pendidikan IPA Indonesia (JPII), 1(2), 115–122.

Baker, D. & T. (2007). The effect of culture on the learning of science in nonwestern countries: the result of and integrated research review. Intenational Journal of Science Education, 16, 1–16.

Bakır, S., & Öztekin, E. (2014). CREATIVE THINKING LEVELS OF PRESERVICE SCIENCE TEACHERS IN TERMS OF DIFFERENT VARIABLES. Journal of Baltic Science Education, 231–242.

Batlolona, J. R., Baskar, C., Kurnaz, M. A., & Leasa, M. (2018). The improvement of problem-solving skills and physics concept mastery on temperature and heat topic. Jurnal Pendidikan IPA Indonesia, 7(3), 273–279. https://doi.org/10.15294/jpii.v7i3.12432

Battiste, M. (1993). Indigenous Knowledge : Foundations for First Nations.

Bee, B. (2012). The Impact of Teachers' Communication Skills on Teaching: Reflections of Pre-service Teachers on their Communication Strengths and Weaknesses. Journal Humanising Language Teaching.

Beer, D., Josef, & Whitlock, E. (2022b). Indigenous Knowledge in the Life Sciences Classroom : Put on Your de Bono Hats ! Published By : National Association of Biology Teachers 1VU PO : PVS EF # POP) BUT. 71(4), 209–216.

Berkant, H. G., & Eren, I. (2013). Investigating problem solving skills of students of primary school math teaching department in terms of some variables. International Journal of Social Science, 6(3), 1021–1041.

Bolden, D. S., Harries, T. V, & Newton, D. P. (2010). Pre-service primary teachers ' conceptions of creativity in mathematics. 143–157. https://doi.org/10.1007/s10649-009-9207-z

Bray, B., France, B., & Gilbert, J. K. (2012). Identifying the Essential Elements of Effective Science Communication : What do the experts say ? 2(1), 23–41.

Brownell, S. E., Price, J. V, & Steinman, L. (2013). Science Communication to the General Public : Why We Need to Teach Undergraduate and Graduate Students this Skill as Part of Their Formal

Scientific Training. 12(1), 6–10.
Busyairi, A., & Sinaga, P. (2015). PROFIL KETERAMPILAN PEMECAHAN MASALAH SECARA KREATIF SISWA SMA PADA POKOK BAHASAN LISTRIK DINAMIS. SNF2015-IV-23 SNF2015-IV-24. IV 23–28.
Chan, Z. C. Y. (2013). A systematic review of creative thinking / creativity in nursing education. Nurse Education Today YNEDT, 33(11), 1382–1387. https://doi.org/10.1016/j.nedt.2012.09.005
Chang, C. (2010). Does Problem Solving = Prior Knowledge + Reasoning Skills in Earth Science ? An Exploratory Study. 88, 103–116. https://doi.org/10.1007/s11165-008-9102-0
Cheng, V. M. Y. (2011). Infusing creativity into Eastern classrooms : Evaluations from student perspectives. Thinking Skills and Creativity. 6(1), 67–87. https://doi.org/10.1016/j.tsc.2010.05.001
Christiyoda, S., Widoretno, S., & Karyanto, P. (2016). Pengembangan modul berbasis kemampuan pemecahan masalah pada materi sistem ekskresi untuk meningkatkan berpikir kritis. 5(1), 74–84.
Crebert, G., Patrick, C. J., & Cragnolini, V. (2011). Griffith Graduate Attributes Ethical Behaviour and Social Responsibility Toolkit Table of contents (Issue D). Griffith University.
Creswell, J. W., & Clark, V. . (2018). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. SAGE Publications. https://books.google.co.id/books?id=4uB76IC%5C_pOQC
Crilly, N. (2015). Fixation and creativity in concept development: The attitudes and practices of expert designers. 38, Design Stu 54–91.
Cropley, A. J. (1997). Fostering creativity in the classroom: General principles. The Creativity Research Handbook, Creskill, NJ: Hampton Press, 83– 114.
Daud, A. M., Omar, J., Turiman, P., & Osman, K. (2012). Creativity in Science Education. 59, 467–474. https://doi.org/10.1016/j.sbspro.2012.09.302
Davidovitch, N., & Milgram, R. M. (2010). Creative Thinking as a Predictor of Teacher Effectiveness in Higher Education. 37–41.
Davis, J. D., Roth, A., Drake, C., & Seiwell, A. (2018). Teachers ' perceptions of the o ffi cial curriculum : Problem solving and rigor. 1–10.
Devito, J. A. (2013). The Interpersonal Communication Book Ed.13th. Pearson.
Dewi, C. A., & Mashami, R. A. (2019). The Effect of Chemo-Entrepreneurship Oriented Inquiry Module on Improving Students' Creative Thinking Ability. Journal of Turkish Science Education, 16(2), 253–263..
Doménech-betoret, F., Gómez-artiga, A., & Lloret-segura, S. (2014). Personal variables , motivation and avoidance learning strategies in undergraduate students. Learning and Individual Differences. 35, 122–129. https://doi.org/10.1016/j.lindif.2014.06.00
Dostal, J. (2015). Procedia Social and Behavioral Sciences. 2798–2805. https://doi.org/10.1016/j.sbspro.2015.01.970
Duff, M. C., Kurczek, J., Rubin, R., Cohen, N. J., & Tranel, D. (2014). Hippocampal amnesia disrupts creative thinking. 23(12), 1143–1149. https://doi.org/10.1002/hipo.22208.Hippocampal
East, M. (2015). Taking communication to task – again: What difference does a decade make? The Language Learning Journal. 43, 1–14. https://doi.org/10.1080/09571736.2012.723729
Ekici, G. (2010). Factors affecting biology lesseon motivation of high school students. Procedia Social and Behavioral Sciences, 2(2), 2137–2142. https://doi.org/10.1016/j.sbspro.2010.03.295
Elliott, S. N., Kratochwill, T. R., Littlefield Cook, J., & Travers, J. (2000). Educational psychology: Effectiveteaching, effective learning (3rd ed.). Bosl College.
Erİgüç, G., Tolga, S., & Huseyin, E. (2013). Evaluation of communication skills: a vocational high school students sample. Hacettepe Health Management Journal, 16(1), 46–65.
Ermasari, G., Subagia, I. W., Bagus, I. D. A., Sudria, N., Studi, P., Sains, P., Pascasarjana, P., & Ganesha, U. P. (2014). KEMAMPUAN BERTANYA GURU IPA DALAM PENGELOLAAN. Jurnal Program Pascasarjana Universitas Ganesha, 4(1), 857–869.
Faelasofi, R. (2017). Identifikasi Kemampuan Berpikir Kreatif Matematika Pokok Bahasan Peluang. JURNAL E-DuMath, 3(2), 155–163. https://doi.org/10.26638/je.460.2064

Fasasi, R. A. (2017). Effects of ethnoscience instruction , school location , and parental educational status on learners ' attitude towards science. https://doi.org/10.1080/09500693.2017.1296599

Fatmawati, B. (2011). Pembelajaran Berbasis Proyek Untuk Meningkatkan Keterampilan Berpikir Kreatif Mahasiswa. Jurnal Pengajaran MIPA, 16(2), 85–92.

Fauziyah, Y. N. (2011). Analisis kemampuan guru dalam mengembangkan keterampilan berpikir kreatif siswa Sekolah Dasar V pada pembelajaran Ilmu Pengetahuan Alam. 2, 98–106.

Ginting, F. W. (2021). ANALISIS KEMAMPUAN PEMECAHAN MASALAH MAHASISWA CALON GURU FISIKA DALAM MENYELESAIKAN SOAL DINAMIKA ROTASI. Jurnal Pendidikan Fisika, 10(1), 60–66.

Gray, F. E., Emerson, L., & Mackay, B. (2005). Meeting the Demands of the Workplace : Science Students and Written Skills. 14(4).

Greenstein, L. M. (2012). Assessing 21st Century Skills: A Guide to Evaluating Mastery and Authentic Learning. In SAGE Publications. https://books.google.co.id/books?id=uHWu%5C_pPEPiUC

Guilford, P. (1970). Creativity : Retrospect and Prospect. The Journal of Creative Behavior, 4(3), 149–168.

Guo, L. (2014). Preparing Teachers to Educate for 21st Century Global Citizenship: Envisioning and Enacting. Journal of Global Citizenship & Equity Education, 4(1), 1–23.

Hadi, W. P., & Ahied, M. (2017). Kajian Etnosains Madura dalam Proses Produksi Garam sebagai Media Pembelajaran IPA Terpadu. 10(2), 79–86.

Hambleton, R. K., & Swaminathan, H. (1985). Item response theory: Principles and applications. Boston: Kluwer-Nijhoff Pub.

Hartati, M. (2017). ANALISIS CERITA PENDEK TUGAS MAHASISWA PRODI PENDIDIKAN BAHASA DAN SASTRA INDONESIA IKIP PGRI PONTIANAK. Jurnal Edukasi, 15(1), 116–127.

Holbrook, J., Rannikmae, M., & Taylor, N. (2009). The Meaning of Scientific Literacy. International Journal of Science and Mathematics Education, 8(5), 821–843.

Hosseini, A. S., & Watt, A. P. (2010). The effect of a teacher professional development in facilitating students ' creativity. Educational Research and Review.

Huang, Y., & Lin, S. (2016). An inventory for assessing interpersonal communication competence of college students. British Journal of Guidance & Counselling, 1–17. https://doi.org/10.1080/03069885.2016.1237614

Hwang, R. Y., Zhong, L., Xu, Y., Johnson, T., Zhang, F., Deisseroth, K., & Carolina, N. (2007). Nociceptive neurons protect Drosophila larvae from parasitoid wasps. Current Biology, 17(24), 2105–2116. https://doi.org/10.1016/j.cub.2007.11.02

Istiyono, E. (2017). The Analysis of Senior High School Students ' Physics HOTS in Bantul District Measured Using PhysReMChoTHOTS. https://doi.org/10.1063/1.4995184

Joseph, M. . (2010). Etnhoscience and problem of method in the social scientific study of religion. Oxfordjournal, 39(3), 241–249.

Julianto, Wasis, & Agustini, R. (2018). Profil Sikap Terhadap Sains, Keterampilan Berpikir Proses Sains, dan Kreativitas Mahasiswa Jurusan PGSD FIP UNESA Di Mata Kuliah Konsep Dasar IPA. Jurnal Pendidikan Dasar, 11(1), 10–15.

Karatas, I., & Baki, A. (2013). The Effect of Learning Environments Based on Problem Solving on Students ' Achievements of Problem Solving. International Electronic Journal of Elementary Education, 5(3), 249–268.

Kennedy, I. G., Latham, G., & Jacinto, H. (2016). Education Skills for 21st CenturyTeachers: Voices Froma Global Online Educators' Forum.

Khalik. (2014). Filsafat Komunikasi.

Khan, A., Zia-ul-islam, S., Khan, M., & Education, P. (2017). Communication Skills of a Teacher and Its Role in the Development of the Students ' Academic Success. Journal of Education and Practice, 8(1), 18–21.

Kvrayici, C. (2020). Communication skills and classroom management competency: the mediating role

of problem solving skills. Journal of Teacher Education and Educators, 9(1), 125–137.
Lederman, D. (2012). Confounded by contradictions. Inside Higher Ed.
Lidi, M. W., Daud, M. H., & Bolong, M. Y. M. (2020). Potensi Kearifan Lokal Tambi Uma Suku Ende Sebagai Sumber Belajar Biologi Dan Pendidikan Karakter. Jurnal Pendidikan Biologi, 12(1), 45–51.
Livne, N., Livne, O., & Wight, C. A. (2008). ENHANCING MATHEMATICAL CREATIVITY THROUGH MULTIPLE SOLUTIONS TO OPEN-ENDED PROBLEMS ONLINE.
Lizbeth, D., Isela, K., María, A., & Ángel, M. (2017). Observation Codes to Evaluate Interpersonal Skills in Healthcare Students in a Observation Codes to Evaluate Interpersonal Skills in Healthcare Students in a Mexican University.
Lotter, C., Singer, J., & Godley, J. (2009a). The Influence of Repeated Teaching and Reflection on Preservice Teachers' Views of Inquiry and Nature of Science. Journal of Science Teacher Education, 20, 553–582. https://doi.org/10.1007/s10972-009-9144-9
Lunenburg, F. C. (2010). The Principal and the School : What Do Principals Do ? 27(4), 1–13.
Makiyah, Y. S., Malik, A., Susanti, E., & Mahmudah, I. . (2019). Higher order thinking real and virtual laboratory (HOTRVL) untuk meningkatkan keterampilan abad ke-21 mahasiswa pendidikan fisika. Jurnal Diffraction, 1(1), 1–5.
Middleton, M., Dupuis, J., & Tang, J. (2012). Classrooms and culture: the role of context in shaping motivation and identity for science learning in indigenous adolescents. International Journal of Science and Mathematics Education, 11(1), 111–141.
Morreale, S., Staley, C., & Stavrositu, C. (2015). First-Year College Students ' Attitudes toward Communication Technologies and Their Perceptions of Communication Competence in the 21st Century. https://doi.org/10.1080/03634523.2014.978799
Muhtadi, D., Supratman, & R, H. (2019). The students' mathematical critical thinking process reviewed from the cognitive style. Journal of Physics: Conference Series.
Newton, L. (2009). Some student teachers ' conceptions of creativity in school science Durham. https://doi.org/10.1080/02635140802658842
Ngasike, J. T. (2011). Turkana Children ' s Rights to Education and Indigenous Knowledge in Science Teaching in Kenya JOHN TERIA NG ' ASIKE. New Zealand Journal of Teachers' Work, 8(1), 55–67.
Novia, Nurjannah, & Kamaluddin. (2015). Penalaran Kausal dan Analogi Berbasis Etnosains dalam Memecahkan Masalah Fisika. Prosiding Simposium Nasional Inovasi Dan Pembelajaran Sains, 445–448.
Noviyanti, M. (2011). Manfaat Keterampilan Berkomunikasi Mahasiswa. Jurnal Pendidikan, 12(2), 80–88.
Nurita, T., Hastuti, P. W., & Sari, D. A. P. (2017). Problem Solving Ability of Science Students in Optical Wave Courses. Jurnal Pendidikan IPA Indonesia, 6(2), 341–345. https://doi.org/10.15294/jpii.v6i2.8184
OECD. (2003). OECD FUTURE OF EDUCATION AND SKILLS 2030 OECD Learning Compass 2030 OECD Future of Education and Skills.
Parmin. (2017). Ethnosains. Semarang : Swadaya Manunggal.
Perin, D. (2011). Facilitating Student Learning Through Contextualization. 29.
Purwandari, P. (2018). Pembelajaran fisika inkuiri terbimbing dengan metode eksperimen dan poyek ditinjau dari kreativitas dan kemampuan berpikir kritis siswa. 2(1), 39–46.
Rahman, Sopandi, W., Widya, R. N., & Yugafiat, R. (2019). Literacy in The Context of Communication Skills for The 21st Century Teacher Education in Primary School Student. International Journal of Science and Applied Science: Conference Series, 3(1), 101–108. https://doi.org/10.20961/ijsascs.v3i1.32462
Rahmawati, & Nizam. (2018). Meningkatkan Capaian Matematika Siswa Indonesia : Kajian Kesalahan Konsep Nilai Tempat. Indonesian Journal of Educational Assessment, 1(1), 1–10.

Rahmazatullaili, R., Zubainur, C. M., & Munzir, S. (2017). Kemampuan berpikir kreatif dan pemecahanmasalah siswa melalui penerapan model projectbased learning. Beta Jurnal Tadris Matematika, 10(2), 166–183.

Ramaraju, S. (2012). Psychological Perspectives On Interpersonal Communication. Journal of Arts, Science & Commerce, 4(2), 68–74.

Research Online Deposited in DRO : Version of attached file. (n.d.). https://doi.org/10.1080/02635140802658842

Ridho, S., Wardani, S., & Saptono, S. (2021). Journal of Innovative Science Education Development of Local Wisdom Digital Books to Improve Critical Thinking Skills through Problem Based Learning. 10(37), 1–7.

Riyadi, A., Gunawan, & Ardhuha, J. (2017). Pengaruh Penerapan Model Pembelajaran Kontekstual Berbantuan Media Flash Terhadap Pemahaman Konsep Fisika Siswa. Jurnal Pendidikan Fisika Dan Teknologi, 1(2). https://doi.org/10.29303/jpft.v1i2.240

Robert, S., Maclin, O., & MacLin, M. (2010). Cognitive Psychology 8/e: Indonesian edition.

Salkind, N. J. (2004). An introduction to theories of human development. Sage Publications. https://doi.org/10.4135/9781483328676

Saptono, S., & Mubarok, I. (2021). Kemampuan Pemecahan Masalah Mahasiswa Calon Guru Biologi Dalam Konteks Socioscientific Issues. Prosiding Semnas Biologi Ke-9.

Sardjiyo, & Panen. (2005). Pembelajaran Berbasis Budaya Model Inovasi Pembelajaran Dan Implementasi Kurikulum Berbasis Kompetensi. Jurnal Pendidikan, 6(2), 83–98.

Sarwi., & Subali, B. (2019). IPA Terpadu Berbasis Etnosains. Semarang: LP3 UNNES.

Satriani, Rafiqah, & Ikbal, M. (2018). Pengembangan Lembar Kerja Peserta Didik Berbasisetnosains Dengan Model Penalaran Kausaluntuk Memecahkan Masalah. Jurnal Pendidikan Fisika, 6(1), 8–16.

Savendra, A., & Opfer, V. (2012). Teaching and Learning 21st Century Skills: Lesson from the Learning Science. A Global Cities Education Network Report. New York , Asia Society.

Selçuk, G. S., Çal, S., & Erol, M. (2008). The Effects of Problem Solving Instruction on Physics Achievement , Problem Solving Performance and Strategy Use.

Smith, C., Nerantzi, C., & Middleton, A. (2014). Promoting Creativity in Learning and Teaching. Educational Development in a Changing World - Proceedings of the ICED.

Snively, G., Corsiglia, J., & Cobern, W. W. (2001). Discovering indigenous science: Implications for science education. Science Education, 85(1), 6–34. https://doi.org/10.1002/1098-237X(200101)85:1%3C6::AID-SCE3%3E3.0.CO;2-R

Stanley, W. B., Brickhouse, N. W., & Cobern, W. W. (2001). Teaching sciences: The multicultural question revisited. Science Education, 85(1), 35–49. https://doi.org/10.1002/1098-237X(200101)85:1%3C35::AID-SCE4%3E3.0.CO;2-6

Sternberg, R. (2003). A Broad View of Intelligence: The Theory of Successful Intelligence. Consulting Psychology Journal: Practice and Research, 55, 139–154. https://doi.org/10.1037/1061-4087.55.3.139

Suastra, I. W. (2010). Model Pembelajaran Sains Berbasis Budaya Lokal untuk Mengembangkan Kompetensi Dasar Sains dan Nilai Kearifan Lokal di SMP. Jurnal Pendidikan Dan Pengajaran, 2, 8–16.

Sudarmin. (2014). Pendidikan karakter, etnosains dan kearifan lokal [Fakultas Matematika Dan Ilmu Pengetahuan Alam, UNNES]. http://lib.unnes.ac.id/27040/1/cover_PENDIDIKAN_KARAKTER_SUDARMIN.pdf

Sugiyono. (2010). Metode Penelitian Pendidikan Pendekatan Kuantitatif, kualitatif, dan R&D. Bandung: Alfabeta.

Suhanti, I. Y., Puspitasari, D. N., & Noorrizki, R. D. (2018). Keterampilan Komunikasi Interpersonal Mahasiswa UM. Prosiding Seminar Nasional Psikologi Klinis, 32.

Sumarni, W. (2018). Pembelajaran Kimia Dalam Kehidupan Berbasis Proyek Terintegrasi Etnosains Bagi Mahasiswa Calon Guru.

Supriyadi, S., Haeruddin, H., & Nurjannah, N. (2016). Peningkatan kemampuan memecahkan masalah antara model penalaran kausal berbasis etnosains dan sains modern. Jurnal Riset Dan Kajian Pendidikan Fisika, 3(2). https://doi.org/10.12928/jrkpf.v3i2.5142

Suryanti, S., Mariana, N., Yermiandhoko, Y., & Widodo, W. (2020). Local wisdom-based teaching material for enhancing primary students' scientific literacy skill. Jurnal Prima Edukasia, 8(1), 96–105. https://doi.org/10.21831/jpe.v8i1.32898

Sutarno, S., Setiawan, A., Suhandi, A., Karniawati, I., & Putri, D. H. (2017). Keterampilan Pemecahan Masalah Mahasiswa Dalam Pembelajaran Bandul Fisis Menggunakan Model Problem Solving Virtual Laboratory. Jurnal Pendidikan Fisika Dan Teknologi, 3(2), 164–172.

Tanyanyiwa, V. I. (2019). Indigenous Knowledge Systems and the Teaching of Climate Change in Zimbabwean Secondary Schools. SAGE Open, 9(4). https://doi.org/10.1177/2158244019885149

Torrance, E. P. (1964). Teaching for Craetive. Georgia: The University of Georgia.

Ulger, K. (2018). The effect of problem-based learning on the creative thinking and critical thinking disposition of students in visual arts education. Interdisciplinary Journal of Problem-Based Learning, 12(1), 3–6. https://doi.org/10.7771/1541-5015.1649

Wahyu, Y. (2017). Pembelajaran Berbasis Etnosains di Sekolah Dasar. Jurnal Inovasi Pendidikan Dasar, 1(2), 140–147.

Wahyuningsih, A. S., Poedjiastoeti, S., & Suyono, S. (2017). the Effect of Green Chemistry Laboratory Learning on Pre-Service Chemistry Teachers' Environmental Value Orientations and Creative Thinking Skill. JPPS (Jurnal Penelitian Pendidikan Sains), 5(1), 848. https://doi.org/10.26740/jpps.v5n1.p848-858

Wang, L. (2017). The inhibition of protein translation mediated by AtGCN1 is essential for cold tolerance in Arabidopsis thaliana. Plant Cell Environ, 40(1), 56–68.

Wasis. (2016a). Hasil Pembelajaran Sains di Indonesia:Problem dan Upaya mengatasinya. Makalah Utamadalam Seminar Nasional Pendidikan Sains.

Wasis. (2016b). Hasil Pembelajaran Sains di Indonesia:Problem dan Upaya mengatasinya Makalah Utamadalam Seminar Nasional Pendidikan Sains. Surabaya:Pascasarjana UNESA.

Wilkins, K. G., Bernstein, B. L., & Bekki, J. M. (2015). Measuring Communication Skills: The STEM Interpersonal Communication Skills Assessment Battery. Journal of Engineering Education, 104(4), 433–453. https://doi.org/10.1002/jee.20100

Winarto, W., Cahyono, E., W., S. ., Sulhadi, S., Wahyuni, S., & Sarwi, S. (2022). Science Teaching Approach Ethno-SETSaR To Improve Pre-Service Teachers Creative Thinking and Problem Solving Skills. Journal of Technology and Science Education, 12(2), 327–344.

Woon Chia, L., & Goh, C. C. M. (2016). Teachers' perceptions, experience, and learning. Asia Pacific Journal of Education, 36, 1–4.

Yuliana, I., Cahyono, M. E., Widodo, W., & Irwanto, I. (2021). The effect of ethnoscience-themed picture books embedded within contextbased learning on students' scientific literacy. Eurasian Journal of Educational Research, 92, 317–334. https://doi.org/10.14689/ejer.2021.92.16

Yusuf, I., & Widyaningsih, S. W. (2018). Implementasi Pembelajaran Fisika Berbasis Laboratorium Virtual terhadap Keterampilan Proses Sains dan Persepsi Mahasiswa. Berkala Ilmiah Pendidikan Fisika, 6(1), 18–28.

Zidny, R., Solfarina, S., Aisyah, R. S. S., & Eilks, I. (2021). Exploring indigenous science to identify contents and contexts for science learning in order to promote education for sustainable development. Education Sciences, 11(3). https://doi.org/10.3390/educsci11030114

Zlatić, L., Bjekić, D., Marinković, S., & Bojović, M. (2014). Development of Teacher Communication Competence. Procedia - Social and Behavioral Sciences, 606–610. https://doi.org/10.1016/j.sbspro.2014.01.265

Zubaidah, S. (2016). Keterampilan abad Ke-21, Keterampilan yang diajarkan Melalui Pembelajaran. Artikel Seminar Nasional Pendidikan dengan tema"isu-isu strategis pembelajaran MIPA Abad 21, Program Studi Pendidikan BIologi STKIP Persada Khatulistiwa Sintang-Kalimantan Barat. 2.