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THE EFFECTIVENESS OF THE STEAM LEARNING MODEL WITH LOOSE PARTS MEDIA IN BASIC CHEMISTRY COURSES

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Abstract: Students in pursuing higher education must have theoretical knowledge, supported by critical thinking skills and high creativity. Basic chemistry courses as a foundation in a science study program with abstract material need a deep conceptual understanding. The STEAM-based learning model (*Science, Technology, Engineering, Arts, and Mathematics*) as an innovative learning model is applied to create a hands-on learning experience. This study aims to examine the effectiveness of the STEAM learning model combined with loose *parts* media in increasing student creativity in basic Chemistry courses. The method used was Quasi-experiment with *a one group pretest-posttest design desaign.* Data analysis was carried out with *a t-test* to find out the difference in pretest and posttest scores. The results of the study showed a significant increase in student creativity scores after the implementation of the learning model. The average creativity score increased from 65.3 in the pretest to 87.4 in the posttest. The t-test showed a significant value of 0.001 ($p < 0.05$) which indicated the increase statistically. The conclusion of this study is that the STEAM-based learning model with *loose parts* media can increase student creativity, including: active in discussions, enthusiasm in conveying ideas or opinions to the group, creative in completing the assigned assignments, fun learning activities, and students able to understand abstract chemical concepts better.

Keywords: STEAM, Loose parts, Basic chemistry, Innovative learning, Creativity

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INTRODUCTION

The educational paradigm has undergone many significant shifts along with technological developments. One of the perspectives that underlies the educational process, namely in carrying out learning, is to encourage the importance of applying approaches, methods, and learning models that are right on target based on the objectives, content, methods, and roles of educators and students. The 21st century educational paradigm requires learning to be active, creative, and able to solve problems, master basic knowledge, and have critical thinking skills. Learning that emphasizes the 4Cs (Creativity, Critical Thinking, Collaboration, Communication) Digital literacy, and contextual learning.

One of the approaches in the learning process that can be carried out is through STEAM (Science, Technology, Engineering, Arts, and Mathematics) based learning which is equipped with *Loose parts media* as an exploratory tool (Trailling & Fadel, 2009). Some of the learning characteristics of the STEAM model are interdisciplinary,

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project-based, creative and collaborative, process- and product-oriented, encouraging Higher Order Thinking Skills (HOTS). Components and focuses in the STEAM approach include: (i) Science (observation, natural exploration, experiments); (ii) Technology (use of simple tools, digital media, or applications; (iii) Engineering (Designing solutions to the problem, design process; (iv) Arts (Creative expression, drawing, designing, making visual or motion models); (v) Mathematics (Measurements, logic patterns, data analysis); (vi)

The learning steps with the STEAM approach are as follows: (a) Identification of contextual problems or themes; (b) Exploration of concepts (science, technology, mathematics, art): (c) Planning and design of solutions (engineering); (d) Product/project development; (e) Evaluation and reflection of results; (f) Presentation of results to other groups or the public. Some of the advantages and advantages of the STEAM approach are: improving critical thinking, creativity, and problem-solving skills; encourage meaningful and contextual learning; relevant to the learning needs in the era of Industry 4.0 and Society 5.0. From several previous studies, it has been stated that the STEAM approach provides a more interesting learning process by using loose parts media .

Media *loose parts* are loose, flexible objects that can be manipulated by students to build, design, and create something, encouraging exploration, creativity, and trying to find solutions in solving existing problems. Some examples of objects that are classified as loose parts are: bottle caps, plastic spoons, rubber bands, bolts, toy wheels, cable pieces, wires, small stones, dry leaves, shirt buttons, ice cream sticks, cardboard pieces, plastic cups, drink bottles, plastic food packaging, and so on. The use of loose parts media supports creativity and exploration and is appropriate when used in collaborative and constructivist learning.

Chemistry learning is applied from a constructivistic paradigm that emphasizes learning through the process of actively building understanding based on concrete experience (Piaget, 1952). Learning chemistry is a requirement with understanding concepts, so in learning you must be able to construct concepts with other concepts. In an effort to build a concept so that it is easier to remember, and understood by students in learning Basic Chemistry, it is necessary to use *loose parts media* with a STEAM model approach. Some of the benefits of meida *loose parts* in STEAM learning are: increasing students' active involvement during learning, stimulating creativity and innovation, fostering a concrete understanding of abstract concepts, as a learning media design exercise for students as prospective teachers.

METHOD

The formulation of the problem in this study is how effective is the effectiveness of STEAM learning with loose parts media in basic chemistry courses. The purpose of this research is to examine the effectiveness of the STEAM learning model combined with loose *parts media* in increasing student creativity in basic Chemistry courses in improving understanding of basic chemistry concepts and 21st century skills.

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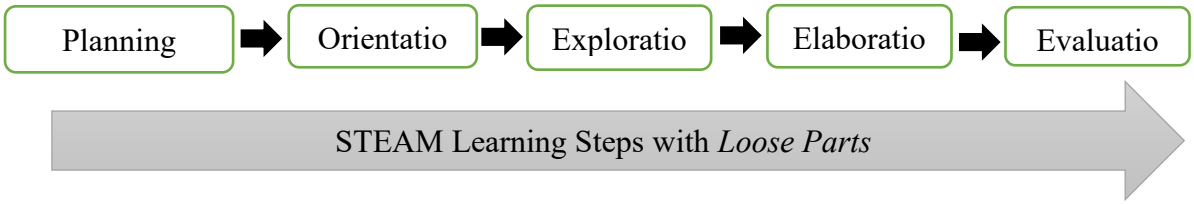
The following is a step-by-step chart of STEAM learning with loose *parts media*:



This study uses a quasi-experimental method with *a one group pretest-posttest design of a non-equivalent control group* Data analysis was carried out with *a t-test* to determine the difference in pretest and posttest scores. The research instrument used a basic chemistry concept understanding test worksheet which was used to measure creativity, problem-solving ability; 21st Century Skills Questionnaire (Creativity, Collaboration, Communication, and Critical Thinking Skills); Observing learning activities.

The research procedure includes several stages, namely: stage 1 collecting initial data on creativity and problem-solving skills through observation and interviews, and performing prestige; stage 2 implementing STEAM learning using *loose parts* media on several topics; stage 3 collecting final data to assess changes in creativity and problem-solving ability after the application of loose parts (postest) media; 4 Analyze the data using descriptive statistical analysis and t-test. Descriptive analysis is used to describe the results of the pretest and postest, while the statistical test paired of T-tests (t-tests) is carried out to test whether there is a difference between the results of the pretest and postest, to determine if there is an improvement in creativity and problem-solving skills. The population of this study is students in the Mathematics Education Study Program, Faculty of Teacher Training and Education, University of Palangka Raya with a sample of 30 students in semester 1 who are taking Basic Chemistry courses.

RESULT AND DISCUSSION

Basic Chemistry Course I

Basic Chemistry I is one of the courses that must be taken by S1 students in the Department of Mathematics and Natural Sciences education, Faculty of Teacher Training and Education, University of Palangka Raya. This course provides basic knowledge in studying chemistry in preparing students as prospective teachers. This course is a branch of chemistry that studies the structure, properties of composition, and the transformation of materials and the energy that comes with it. The science contained in the topic of learning is an important foundation in understanding various natural phenomena and the application of technology in daily life.

Here are some key concepts in basic chemistry:

(1) The basic concepts of chemistry about: the scope of chemistry, the scientific method, atoms and molecules, elements and compounds.

(2) Branches of chemistry, basic laws of chemistry, periodic systems of elements, atomic structure.
(3) Stokiometry and chemical reactions, substance forms and phase changes.

In this study, the effectiveness test was carried out on several topics discussed as the focus of the research, namely on the topic of periodic systems of elements and atomic structure. This is based on initial observations in the previous semester on this topic that students said they had difficulties in learning it.

Pretest and Postest Cognitive Data Tabulation

Class	Average St.Deviation			Test		
	Prates	Post-tests	N-Gain	Normality N-Gain	N-Gain homogeneity	Independent Sample t-test
Experiment	38.93 ± 8.75	77.14±7.98	0.62± 0.14	0.200> 0.05	0.351>0.05	Mark (2 tails) 0.000<0.05
Control	35.00 ±9.45	54.31± 12.59	0.29±0.17	0.200> 0.05		

Based on Table 1 above, it is known that the scores in the experimental class have an average of 38.93 for the pretest, 77.14 for the posttest, and 0.62 for the N-gain with the "moderate" criteria, while in the control class the average values are 35.00 for the pretest, 54.31 for the posttest, and 0.29 for the N-gain with the "low" criterion. The results of the pretest, posttest, and N-gain calculations showed that the cognitive learning outcomes in the experimental class were higher than those in the control class.

The results of the study showed a significant increase in student creativity scores after the implementation of the learning model. The average creativity score increased from 65.3 in the pretest to 87.4 in the posttest. The t-test showed a significant value of 0.001 ($p < 0.05$) which indicated the increase statistically.
Some pictures of learning results are presented in the following figure 2:

CONCLUSION

The conclusion of this study is that the STEAM-based learning model with *loose parts* media can increase student creativity, including: active in discussions, enthusiasm in conveying ideas or opinions to the group, creative in completing the assigned assignments, fun learning activities, and students able to understand abstract chemical concepts better.

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The application of the STEAM learning model with loose parts media in basic chemistry courses is effective and has not been widely researched. This approach has great potential to improve the understanding of concepts and skills of students as prospective teachers. However, more research is needed to adapt and evaluate the effectiveness of this approach at the college level.

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