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Concept Attaiment Model Based on Traditional Technology Organizers for Strengthening Global Science Literacy and Creative Character

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Abstract: This study aims to obtain a concept attaiment model based on traditional technology organizers that is feasible, practical, and effective to strengthen global science literacy and creative character. This research uses the Borg and Gall development research model with stages, including: information collection research, planning, initial development, initial testing (initial field testing), main product revision, main testing (main field testing), operational product revision, operational field testing, final product revision, and dissemination. Exploration of traditional technology is carried out to obtain experimental media that will be summarized into organizers for learning media. Hypothetical model validation (FGD-focus group discussion) involves lecturers and education practitioners in West Kalimantan to obtain eligibility. Limited initial field testing with purposive sampling techniques at IKIP PGRI Pontianak with a pre-experimental one group pretest posttest design. Global science literacy is measured using questionnaires. Creative character is measured using scientific creativity tests referencing divergent thinking. The results of the study obtained a concept attaiment model based on traditional technology organizers to strengthen global science literacy and valid creative characters with excellent criteria. The t-test results show that the concept attaiment model based on traditional technology organizers is effective for improving global science literacy and creative character. Students and educators respond well to the application of concept attaiment models based on traditional technology organizers.

Keywords: Concept attainment; Creative character; Global scientific literacy; Traditional technology

Introduction

Pancasila students who believe, fear God; noble character; global celebrity; mutual cooperation; self-sufficient; critical reasoning; and creative is the capital to achieve SDGs (Rusnaini et al., 2021). Environmental SDGs concern must be built early through science by developing global diversity, which leads to the formation of global science literacy (Rahmawati, 2021). The achievement of global science literacy at the international and national levels shows a low score (Castello et al., 2020; Mun et al., 2015; Pahrudin et al., 2019; Pramuda et al., 2019). In Pontianak City, it shows 75% of students on medium and low scores (Pramuda et al., 2019). In Lampung, 80% of students are at medium and low levels (Pahrudin et al., 2019). This shows that students are not yet aware as global citizens, have not played a creative role in overcoming socioscientific, sustainable, and environmental issues. Creativity is a character value according to the Pancasila student profile (Hidayah et al., 2021; Walsiyam, 2021).

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The development of creative character in science accelerates the achievement of SDGs (Erlina, 2021; Mubin AM, 2021). Creative character must be cultivated because in various regions it is still low (Meiarti, 2021). The creative character profile of students in Demak is only 56.67% in the medium category (Hidayati et al., 2020), in Tanjung Pinang in 51.42% in the medium and low categories (Hidayati et al., 2020), in Surakarta at 39% or low (Kurnia, 2021). Learners need to learn to use the potential in the environment to be creative in solving global problems.

Creative characters are documented in sustainable cultural heritage artifacts (Indrawan et al., 2020; Niman, 2019). Cultural heritage in the environment of learners needs to be preserved (Lubis et al., 2020; Syamsurrijal, 2020). Traditional technology reviews the condition of online-offline learning with great potential and close to the environment of students (Juhaeri'ah et al., 2021). Traditional technologies have not been utilized in STEM learning related to scientific inquiry and technological design (Ediwar et al., 2019; Surya et al., 2019). Various STEM models related to aspects of local wisdom have not specifically built global science literacy and creative character through scientific investigation and impactful technological design (Adi, 2021; Nurjaman et al., 2018). There is no synergy between modern technology, such as sensors, augmented reality, or IoT with traditional technology in STEM-oriented science learning (Astuti et al., 2021; Atkin et al., 2020; Pramuda et al., 2018).

The concept attainment model is useful for forming creative characters. Learners engage meaningful inquiry with the exploration of local potential. The weakness is that it does not accommodate many elements of interactivity, so it needs to be combined to build global science literacy (Nelie et al., 2018; Yuliati et al., 2018). On the other hand, the advance organizer model facilitates many elements of interactivity such as the complexity of material and cultural structures (Kalsum et al., 2021; Nisyah et al., 2019). The combination of the two models in the direction of STEM-oriented science learning utilizing traditional technology as a means of exploring concepts and values holistically does not yet exist (Azizah, 2023; Nuralita, 2022; Widyaningrum, 2018). Traditional and modern technologies (sensors, augmented reality, and IoT) can be combined into organizers for concept attainment so that students have a complete understanding of science and culture that encourages the formation of global science literacy and creative character.

The weaknesses of these studies can be overcome by combining the concept attainment model with a technology organizer into a concept attaiment model based on traditional technology organizers. The combination of concept attaiment models based on traditional technology organizers according to the grand theory of constructivism with the scaffolding of social constructivism. This combination is projected to be feasible to improve global science literacy and creative character of learners. The creative character and global science literacy are instructional impacts. Another Pancasila student profile is the impact of nurturant. The achievement of research objectives is in line with the leading fields of education and innovative learning in the fields of Mathematics and Natural Sciences, technology, social, and humanities with the topic of Student Centered Learning (SCL)-based learning models. The technology organizer-based concept attaiment model leads active students through local potential-based experiments so that learner-centered learning is in line with the IKIP PGRI Pontianak Research Plan, namely the topic of Student Centered Learning (SCL)-based learning models.

Method

This research is a development research, referring to Borg et al. (1998) with ten stages, including: research and information collection, planning, initial development, initial testing, main product revision, main testing, operational product revision, operational field testing, final product revision, and dissemination. The flow of research activities is presented in Figure 1. Model trials are carried out in a limited scope at this initial testing stage. Revisions were made and continued on main and operational field testing so that a final model was obtained. The initial field testing was carried out on a limited basis in semester 1 of the Physics Education study program IKIP PGRI Pontianak with a pre-experimental one group pretest postest design. Learning with the model developed in the initial field test stage was carried out as many as 2 meetings.

Initial and primary field testing using a pre-experimental one group pre-test post-test design refers to Cohen et al. (2018) as in Table 1. Operational field testing using a quasi-experimental pre-test post-test non-equivalent group design refers to Anderson-Cook (2005) as in Table 1.

Table 1. Pre-Experimental One Group Pre-Test Post-Test Design on Initial and Main Field Testing refers to (Cohen et al. (2018)

Class	Initial test	Treatment	Final test
Experimental	O_1	Model X	O_2

The independent variable in this study is the learning model. The dependent variables in this study are global science literacy and creative character. A and redefinition. Research subjects involved in the research, namely: experts, peer lecturers, and students. Experts and lecturers as research subjects to obtain the feasibility of the developed learning model. Students as subjects are selected by cluster random sampling technique. Students as subjects involved are 2nd semester students to obtain data on the effectiveness of models and responses. The research was conducted at IKIP PGRI Pontianak, West Kalimantan. The study will be conducted from May 2023 to November 2023.

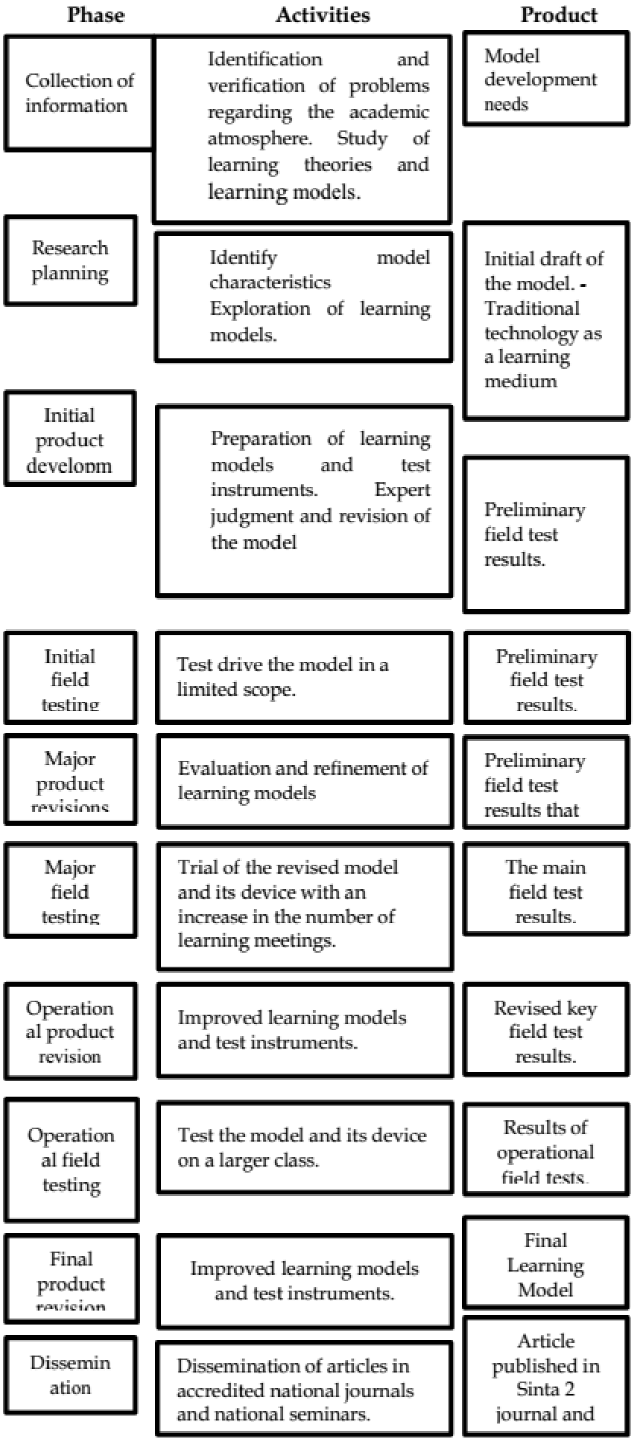

Figure 1. Research flow

Learning model is a series of learning steps. Global science literacy in this study is the knowledge of learners related to science today. The creative character in this study is divergent thinking based on knowledge in terms of fluency, flexibility, originality, elaboration, Data collection techniques in this study consist of test and non-test techniques. Test techniques are used to measure the effectiveness of models with data collection tools in the form of science literacy tests and creative character. Non-test data collection techniques in the form of student response questionnaires to the model and validation sheets for model feasibility. The data obtained in this study are qualitative and quantitative data. Qualitative data in the form of traditional technology tools that can be used as learning media and summarized into technology organizers and then processed descriptively. Quantitative data obtained from the results of model trials in the analysis of feasibility, practicality, and effectiveness of the model.

The feasibility of the learning model is determined based on the results of validation by experts. The feasibility of the learning model is determined from the average score of the validator assessment and then the eligibility criteria are determined referring to Table 2. Table 2 shows guidelines for assessing the quality of a learning tool. x_i is the ideal average, which is half of the maximum and minimum ideal scores, while Sbi is the standard deviation, which is one-sixth of the difference between the maximum score and the ideal minimum score (Widoyoko, 2017).

The main field testing uses one experimental class by applying tests at the beginning and end of learning. Parametric paired sample T test is carried out in the main field test because the research design uses one class of experiment. The normality and homogeneity test of the data is carried out as a prerequisite test for analysis before statistical tests.

Table 2. Learning Tools Quality Assessment Guidelines (Widoyoko, 2017)

Score Interval	Criterion
$\bar{X} > \bar{x}_i + 1.8$ Sbi	Very Worth It
$\bar{x}_i + 0.6$ Sbi $< \bar{X} \leq \bar{x}_i + 1.8$ Sbi	Proper
$\bar{x}_i - 0.6$ Sbi $< \bar{X} \leq \bar{x}_i + 0.6$ Sbi	Enough
$\bar{x}_i - 1.8$ Sbi $< \bar{X} < \bar{x}_i - 0.6$ Sbi	Less
$\bar{X} \leq \bar{x}_i - 1.8$ Sbi	Very lacking

Student responses were obtained from questionnaires in the form of Likert scales and calculated by equations:

$$\%X_{in} = \frac{\sum S}{S_{max}} x100\% \quad (1)$$

With % X_{in} is the percentage of questionnaire answers, $\sum S$ is the sum of respondents' answer scores, and S_{max} is the sum maximum score. Then the data is deduced based on Table 3.

Table 3. Practicality Level Criteria

Percentage (%)	Criterion
80.1 - 100	Very High
60.1 – 80	High
40.1 – 60	Keep
20.1 – 40	Low
0.0 – 20	Very Low

Result and Discussion

Model Feasibility

The concept attaiment model based on traditional technology organizers was validated by 3 Physics Education lecturers to assess the suitability of the developed model with theory, goals, syntax, social systems, reaction processes, and support systems. The constructed model is presented in Figure 2. The results of validation against the model are presented in Table 4.

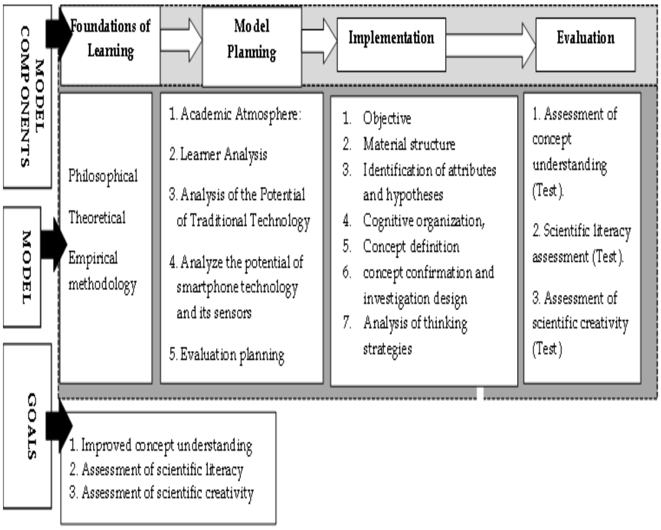

Figure 2. Hypothetical model

Table 4. Results of Expert Validation of Model Feasibility

Aspects	Indicator	Average score	Category
Theory	Suitability of the model with constructivism theory.	4	
	Model conformity to the STS approach	4.25	
	Suitability of the model to the family of information processing models.	4.25	
Purpose	Relevance of the model to the Curriculum.	4.5	
	The relevance of the model to the characteristics of learners.	4.5	
Syntax	Ease of learning steps to be implemented.	4.25	
	Clarity of student activities at each step of learning.	4.75	
Social System	The availability of controlled theme exploration opportunities through group dialogue of learners in the order of learning competencies.	4.25	
	The availability of opportunities to come up with the idea of experimentation.	4.25	
Reaction principle	Availability of opportunities for students to build concept structures.	4.25	
	Availability of opportunities for learners to hypothesize naturally.	4.25	
	Availability of opportunities for learners to focus on specific features of examples.	4.25	Very decent
	Availability of opportunities for learners to evaluate thinking strategies.	4.25	
Support System	Compatibility of traditional technologies as well as smartphones and sensors to the model.	4.5	
	Ease of provisioning required experimentation devices.	4.25	
	Ease of learners to share, create data units, and generalize examples.	4.25	
	Average Score	4.31	

Table 4 shows that the model is very feasible to apply according to expert judgment with excellent criteria. The results of the assessment from experts regarding the feasibility of the model show that the model developed is in accordance with the characteristics of students and physics material at the university level to improve science literacy, and creative character. The concept attainment model based on traditional technology organizers is in line with the studies of Sweller (2016), Kampourakis (2016), Khoiri et al. (2018), Lee (2018), Tandililing (2019), and Suastra (2013), through the use of traditional technology can present empirical learning and observation themes that can strive for the nature of science, and think divergently, to strive to increase scientific literacy, and scientific creativity of students. A model that is worthy of being visualized more clearly in Figure 2 creative performance.

Model Effectiveness

The normality and homogeneity test of data is carried out as a prerequisite test for analysis before conducting statistical tests. Table 5 shows that p value (sig.) > 0.05 means that H_0 is rejected so that it can be concluded that the sample is from a normally distributed population. Table 6 shows that p value (sig.) > 0.05 means that H_0 is rejected so that it can be known that the sample is from a homogeneous population. Table 4 and Table 5 show that the data are normal and homogeneous, so to determine the effect of applying the model a paired sample T test is presented in Table 6. This test was carried out according to the research design used, namely one group pretest posttest.

Table 5. Data Homogeneity Test Results

Variable	Levene's Test				Decision
	F	df1	df2	Sig.	
Science Literacy	0.368	1	62	0.546	Homogeneous
Scientific Creativity	0.929	1	60	0.339	Homogeneous

Table 6. Data Normality Test Results

Variable	Class	Kolmogorov-Smirnov			Decision
		Statistics	Df	Sig.	
Science	Initial test	0.2	31	0.169	Usual
Literacy	Initial test	0.207	31	0.139	Usual
Creative	Initial test	0.135	31	0.147	Usual
characters	Initial test	0.143	31	0.095	Usual

Table 7. Paired Sample T Test Results

Dependent Variable	Sig	Decision
Science Literacy	0.000	There is a difference
Scientific Creativity	0.000	There is a difference

Table 7 shows a signification value of < 0.05. This shows that H_0 rejected means that there are differences in science literacy and creative character of students before and after learning with the concept attaiment model based on traditional technology organizers.

This is in line with the leveling of scientific work in education units (Minister of Education and Culture of the Republic of Indonesia, 2016) and studies from Suhariyono et al. (2019). Students after learning using the developed model will be able to define concepts meaningfully according to five elements of the concept, namely: names, definitions, attributes, values, and examples. Students can explain why a material is important to learn because of the clear presentation of issues and practical concept maps through the material organizer. Students after learning using models understand well how the process of conducting investigations, experiments or innovative investigations in accordance with scientific rules or methods using traditional technology experimental systems. Students will be productive, creative, and innovative. The end result is a balanced physics learning between aspects of competence, attitudes, skills, and knowledge.

Response of Learners and Educators to the Model

The responses of learners and educators to learning are presented in Table 8. Table 8 shows that learners and educators respond very well to the application of the model.

The model developed is proven to be practically applied to be able to increase the understanding of concepts, scientific literacy, and scientific creativity of students. This can be seen from the response of students and educators to learning. The assessment of the implementation at each meeting meets the criteria of good. This finding is supported by research by Hochberg et al. (2018), Vogt (2015), Billings et al. (2012) who have examined that learning models that use smartphone tools will be able to better harmonize concept discovery activities, especially from exploration or experimentation regarding a traditional technology, especially in terms of visualization of results and time efficiency. Material organizers supported by screencasts and in line with the presentation of LKPD make educators and students more comfortable, and confident with the media used, enthusiastic, creative, and collaborative. This is in line with research conducted by Hazard (2014) regarding the use of screencasts.

Table 8. Response of Learners and Educators to Learning

Respondents	Average	Category
Student	3.47	Very Hight
Teacher	3.48	Very Hight

Traditional technology involved in learning is able to raise the enthusiasm of students to re-recognize their cultural heritage and follow learning well, as evidenced by the good response of students in each learning phase. This is a good capital to realize cultural resilience and strengthen the character and identity of the nation. Students when learning using learning models are able to show their creativity and critical thinking, one of which is by making experimental prototypes in a more practical form than those presented to the material organizer, thus accelerating the time of taking experimental data. One example is the modification of dynamic trains in impulse momentum experiments. The ability to collaborate and communicate in learning with models is shown by students when sharing experiences using traditional technology, as well as when sharing tasks in observing physical variables and presenting experimental results.

Conclusion

A concept attaiment model based on traditional technology organizers has been obtained to strengthen global science literacy and valid creative characters with excellent criteria. The t-test results show that the concept attaiment model based on traditional technology organizers is effective for improving global science literacy and creative character. Students and educators respond well to the application of concept attainment models based on traditional technology organizers.

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Author Contributions
Conceptualization, Soka Hadiati; methodology, Matsun; validation, investigation, Adi Pramuda. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest
The authors declare no conflict of interest.

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