Journal of Research Administration
Society of Research Administrators International

INTEGRATING APPLIED SCIENCE LEARNING IN THE DEPTHS: DEVELOPMENT AND EVALUATION OF A 'SCIENCE CAVE ENVIRONMENT' MODEL FOR VOCATIONAL HIGH SCHOOL STUDENTS

Nurkolis Bambang Setyowacono *

Concentration in Science Education Postgraduate Program, Universitas Negeri Yogyakarta, Indonesia

*Corresponding author

ABSTRACT

This research focuses on the development and evaluation of an Applied Science learning model seamlessly integrated with the unique cave environment of Goa Gong for vocational high school (SMK) students. Following the research and development (R&D) methodology proposed by Borg & Gall, the study involved tenth-grade SMK students in the vicinity of Goa Gong, Pacitan Regency. Data collection methods included questionnaires, interviews, observations, and documentation. The resulting learning model, termed the "science cave environment," exhibits a well-defined syntactic structure encompassing problem stimulation, student organization for effective learning, action plan formulation, product design, SWOT-based evaluation and prediction, and reflective processes. Supporting learning tools, such as teaching materials, Student Worksheets (LKPD), Lesson Implementation Plans (RPP), images/videos, and comprehensive assessment tools, were an integral part of the developed model. The validation process engaged experts in instructional design, media, subject matter, and Applied Science teachers, collectively confirming the suitability of the science cave environment learning model for implementation. The feasibility test further affirmed the model's effectiveness, with good categories observed in the implementation of syntactic components, reaction principles, social systems, and support systems. The subsequent effectiveness testing, conducted in two phases, demonstrated the superior efficacy of the science cave environment learning model in cultivating workplace-ready characteristics among students. Notably, the model surpassed conventional learning approaches, showcasing a significant difference and reinforcing its potential to better prepare students for the demands of the workforce.

Keywords: Applied Science Learning, Cave Environment Integration, Vocational Education

1. INTRODUCTION

Vocational Education is a practice-oriented approach to education and emphasizes on what to do in the workplace as a result of either learning to meet the requirements of the career or improving student performance on the skill level to be possessed. Students must follow the lessons and skill test based on the standards set by a field of work. The role of the Vocational Education should be considered as a medium that can be combined with elements of e-learning in educational technology and give a better impression on the students, vocational college (VC) and also in terms of careers (Capron Puozzo & Audrin, 2021) The phenomenon at work today is different from the past. It is characterized by global competition, cultural diversity, new technology and new management processes that require employees to have problem solving and critical communication skills and high level of workmanship according to the study done by (Mustapa et al., 2015) The current student generation has been exposed to the technology of the Internet and smart phones since early teenage years as stated by (Malik et al., 2023) who hold that most of the students have experience using the Internet before they enter the educational institution (Moldovan, 2012). A study by (Rott et al., 2022) showed that students prefer to use technologies that they are familiar with such as mobile network, social media and blogs to interact and get information.(Isnandar et al., 2023) Suggested if teachers have their own environment to negotiate the learning needs of students and how it is supposed to connect with students and what form should the communication between students and the learning environment that teachers need to take, then teachers need to make full use of existing facilities. The study by (Kulpa-Puczyńska, 2014) emphasized that blogs are highly motivating to students, excellent opportunities for students to read and write, effective forums for collaboration and discussion and powerful tools to enable the learning or mentoring to occur. In the past five years of social media, many applications such as Facebook, Twitter, YouTube, Google+ and Wikipedia have come to dominate the ways in which digital technology is now used around the world (Vit, 2023) One of the strongest effects of the technology in that study was its ability to promote class discussion among students. This method, which is more effective communicative learning should be sought and practiced in VC so it could be more relevant to improve class attendance and the needs of the students and teachers at present (Yuan et al., 2014) The study conducted by (van Wijlen et al., 2023) listed 40 types of Web 2.0 applications suitable for the use in the teaching and learning (T&L). This application can help teachers and students to face the changing patterns of learning in the new millennium. E-learning strategies are still not being explored extensively in the system of vocational education for the learning process.

2. METHOD

Developing an Applied Science learning model for vocational high school (SMK) students in the Goa Gong cave environment involves a Research and Development (R&D) approach. Following the Borg & Gall model and a 10-step process by Tao et al. (2020), the methodology integrates environmental values based on Fadel Eskander's (2022) development elements. This ensures a systematic approach, including information gathering, planning, field testing, and revisions. Adherence to R&D principles guarantees the product's feasibility and relevance within the SMK learning environment. The study emphasizes key R&D characteristics highlighted by Diniz Bernardo et al. (2021) for effective educational product validation and impact.

2.1 Development Procedure

This methodology outlines the systematic creation of an Applied Science learning model, emphasizing character development for vocational high school students in the Goa Gong cave environment. The development follows a ten-step process inspired by Polyak et al. (2018) and integrates practical and research inputs. Initial stages involve problem identification, literature reviews, and surveys on Applied Science, ecosystem teaching, and the Goa Gong environment. Planning encompasses goal setting and design structuring, while the development phase focuses on creating a Science Cave Environment learning model. Field testing, expert input, and user feedback drive revisions, leading to operational and final product testing. Dissemination involves broad distribution and implementation for wider accessibility, ensuring the model's effectiveness and relevance.

2.2 Product Trial Design

The product trial design ensures the suitability and effectiveness of the developed Applied Science learning model for 10th-grade vocational high school (SMK) students in the Goa Gong cave environment. The selection of Goa Gong as the research location is strategic, aiming to optimize the potential of the natural tourist destination while addressing local environmental issues and fostering community awareness among students and teachers.

The data collected in this study are quantitative and qualitative data. Qualitative data relates to information on field conditions, teacher conditions, student conditions, environmental conditions around Gong cave, and the results of validation from experts. While quantitative data is in the form of learning outcomes test data and data related to characters that support work readiness, namely student questionnaire data to measure creativity, confidence and courage to take a stand.

2.3 Collection Techniques and Instruments

The instruments used in this study consist of instruments to measure the science cave environment learning model device and instruments to measure the effectiveness of the science cave environment learning model.

All data collection tools above will be considered feasible if they have fulfilled the validity and reliability of the instrument. All instruments are first assessed for feasibility by educational experts and practitioners before being applied in schools according to the aspects and indicators from the analysis of expert opinion.

In measuring the effectiveness of student work readiness, a questionnaire was used on creativity, confidence and courage to take a stand. Aspects and indicators are the reference in measuring the instrument.

The following describes the grids and indicators of assessment of science cave environment learning tools

1) Science Cave Environment Learning Model Guidebook

The model guidebook is a guidebook for implementing the science cave environment learning model. The guidebook serves to facilitate model users in its application.

2) Science cave environment teaching materials

Teaching materials are prepared to make it easier for teachers to provide understanding to students in learning science cave environment

3) Learning Implementation Plan (RPP)

Lesson plans were prepared for the theme of ecosystem balance with validation grids.

4) Student Worksheet

The project activities carried out focus on developing the potential of Gong cave in the form of Attractions, Accessibility, Amenity and Activities (4A), while the LKS assessment grid.

5) Cave Environment Product Assessment

The design of the product was first discussed by the students in groups, including how to work and the tools and materials to be used.

2.4 Parent Lesson Book

The liaison book serves a vital role in fostering effective communication between schools and parents, particularly as a tool for monitoring cave environmental care activities, especially at the Gong cave. It serves as a guide for activities in the cave environment, offers information on the route to the cave, ensures maintenance of facilities, and organizes supporting activities in the vicinity.

The data analysis technique employed in this research includes both qualitative and quantitative methods to assess the validity, practicality, and effectiveness of the developed learning model and tools. Quantitative data analysis encompasses observations, questionnaires, and learning outcome tests to evaluate needs, instrument validity, and product effectiveness. Validity analysis involves descriptive calculations for learning devices, while learning outcome tests undergo tests for validity, reliability, differentiation, and difficulty. The validity test uses the product moment correlation coefficient formula to assess the relationship between item scores and total scores. The reliability test ensures consistency, accepting correlations above 0.6. Differential power criteria guide item acceptance. Practicality analysis involves expert assessments, practicality level determination, and criteria establishment, providing a comprehensive evaluation based on predefined guidelines and expert insights.

The criteria for assessing the practicality level of the Science Cave Environment learning model, based on Pérez-Moreno et al. (2016), are delineated into score ranges and corresponding categories. A score range of 90 to 100 is classified as "Very high," 75 to 89 as "High," 65 to 74 as "Enough," 55 to 64 as "Low," and 0 to 54 as "Very low." These categories provide a systematic framework to evaluate and categorize the practicality level of the learning model, ensuring a nuanced understanding of its effectiveness and applicability in educational settings.

The developed model's practicality is deemed acceptable when reaching a "sufficient" level according to expert evaluations. Revisions are made if this threshold isn't met, based on expert input. Field practicality analysis involves summarizing data from observations, teacher activities, and trial responses. Instrument-based guidelines determine practicality levels. Student questionnaires assess satisfaction, while teacher responses offer qualitative insights. Effectiveness analysis, using quasi-experimental methods, measures changes in creativity, confidence, and initiative, testing differences between groups taught the Science Cave Environment model and conventional methods.

3. RESULTS AND DISCUSSION

3.1 Results

The study resulted in a product, namely the Applied Science learning model called "Science Cave Environment." This model was developed based on (Kato et al., 2024) 10-step research and development framework, which includes research and information collecting, planning, developing the preliminary form of the product, preliminary field testing, main product revision, main field testing, operational product revision, operational field testing, final product revision, and dissemination and implementation. In addition to following these ten steps, the researcher also incorporated elements from (Nayak et al., 2023) instructional design principles, encompassing syntax, reaction principles, social systems, support systems, and accompanying impacts, to create an integrated Applied Science learning design with the unique environment of Goa Gong.

3.2 Needs Analysis Results

The research conducted a field survey involving school administrators, teachers, students, and the surrounding environment to analyze the potential of the Goa Gong environment for developing the "Science Cave Environment" learning model. The survey results provided insights into the environmental potential and facilities supporting the development of this learning model. The research involved interviews with school officials from SMKN Pringkuku and SMKN 2 Donorojo. The survey indicated that SMKN Pringkuku encouraged environmental awareness by granting teachers the freedom to integrate environmental issues into the curriculum. On the other hand, SMKN 2 Donorojo showed less support for teachers in developing the local environmental potential for learning.

The survey also assessed the facilities and infrastructure at both schools. Despite some shortcomings, the overall condition of the school surroundings was considered adequate. Additionally, interviews with teachers revealed that Applied Science subjects, particularly topics like Ecosystem Balance, were perceived as challenging due to their theoretical nature and the lack of suitable learning media. The alignment between the learning model's characteristics and the Core Competencies (KI) and Basic Competencies (KD) was considered. The learning model aimed to enhance students' conceptual understanding and self-development for the workforce and society, aligning with Core Competencies point 3. The model also emphasized the development of scientific skills and self-skills across various fields, in line with Core Competencies point 4. The theme "Utilization of Environmental Ecosystems" was analyzed, connecting Core Competencies and Basic Competencies standardized by the government. The development of the Science Cave Environment model required a careful analysis of the theme and a deeper understanding of the environmental potential around Goa Gong.

The "4A and SWOT Analysis" section discussed how the learning model activities, integrated with the Goa Gong environment, applied the 4A approach (Attraction, Accessibility, Amenities, and Activities) and involved SWOT analysis. Despite concerns about time and students' unfamiliarity with SWOT analysis, the model aimed to simplify the process, making it more accessible for students. In summary, the development of the Science Cave Environment learning model was deemed essential, especially for schools near cave locations. This model allows educators to utilize the cave environment as a tangible learning resource. The model's objectives include fostering creativity in students, encouraging them to analyze and utilize the surrounding cave environment, and creating valuable products. The planning of the learning model incorporated syntax resulting from the integration of Applied Science learning about environmental ecosystems with the cave environment. The syntax involved stimulating student interest through a prepared video, organizing students for brainstorming sessions to generate creative ideas, designing products based on the 4A criteria, evaluating and predicting outcomes through a simplified SWOT analysis, and reflecting on the entire process, assessing the significance and usefulness of the learning experience for the students.

3.3 Model Structure Prototype Design

The discussion outlines the design of the prototype structure for the Science Cave Environment learning model, focusing on the development of a learning book and instructional tools.

3.3.1 Learning Book Design:

1. The learning book systematically comprises five sections: Introduction, Science Cave Environment Learning Model, Structure of the Science Cave Environment Learning Model, Classroom Management, and Conclusion.

2. The Introduction section outlines the model's objectives, coverage, management of learning materials, and the target users.

3. The Science Cave Environment Learning Model section includes definitions, underlying theories, and objectives, emphasizing creativity, confidence, and entrepreneurship.

4. The Structure of the Science Cave Environment Learning Model section details the model's components, including syntax, reaction principles, social systems, supporting systems, and instructional impact.

5. The Classroom Management section addresses the characteristics of Applied Science Learning in vocational schools, student characteristics, and instructional tools such as Core

Competencies, Basic Competencies, Indicators, Lesson Plans, Teaching Materials, Worksheets, and Assessments.

2. Results of Learning Tools Design:

1. Lesson Implementation Plan (RPP):

1. Developed for ease of applying the Science Cave Environment learning model in the environmental ecosystem theme.

2. Includes subject identification, core competencies, basic competencies, learning indicators, material outlines, learning models and approaches, learning media, learning activity forms, and assessments.

2. Student Worksheets (LKPD):

1. Comprises three sub-themes: cave ecosystem, geotechnology and hydrology, and cave sustainability.

2. Activities include designing a cave ecosystem-themed poster, measuring temperature and humidity inside the cave, and analyzing cave rock waste products using SWOT.

3. Student Teaching Materials:

Essential for aligning with the developed worksheets, covering the cave ecosystem theme, including introductory, cave ecosystem components, interactions, cave division, geological and hydrological processes, cave formations, rock types, and conservation aspects.

4. Instruments:

Student Assessment Instruments:

Evaluate creativity, discussion processes, SWOT identification results, and student self-assessment.

Research Instruments:

Measure the validity, feasibility (practicality), and effectiveness of the Science Cave Environment learning model and its instructional tools through validation sheets.

The instruments include validation sheets for the learning book, lesson plans, student worksheets, teaching materials, observation sheets for learning model implementation, and student questionnaires on creativity, confidence, and willingness to take action.

4.1.3 Product validation of Science Cave Environment Learning Model

4.1.3.1 Validation Results of the Learning Model Handbook

The learning model guidebook was validated by media experts and material experts. The components of the validation results from the experts are described in detail in the Appendix and briefly in Table 13.

Table 13. Results of Material Expert Assessment of Science Cave Environment Learning Model Guidelines

Component	Average Index	Category
Cover	0,83	Very Good
Writing Style	1,00	Very Good
Presentation of Material	0,83	Very Good
Introduction	0,88	Very Good
Theoretical Foundations	0,83	Very Good
Learning Model Content	0,66	Good

Table 14 Results of Media Expert Assessment of Science Cave Environment Learning Model Guidelines

Component	Average Index	Category
Cover design	0,83	Very Good
Content design	0,85	Very Good

Based on the analysis results in the material expert table, it is concluded that the science cave environment learning model guidebook is declared valid in content with minor revisions. While the validity analysis for media experts can be seen in the table that the results are declared valid with minor revisions.

4.1.3.2 Teaching Material Validation Results

1. Material Expert Validation

Teaching materials assessed by experts are teaching materials with cave environmental ecosystem material in vocational applied science subjects. The results obtained in detail in the appendix and in summary can be seen in Table 15.

Table 15 Results of Assessment of Teaching Materials by Material Experts

Component	Index Average	Category
Content Appropriateness	4	Very suitable
Presentation feasibility	3	Suitable
Language	4	Very suitable
Science Cave Environment Valuation	4	Very suitable

2. Media Expert Validation

Teaching materials assessed by media experts consist of three parts, namely, cover, Layout & Layout, and Content / Material. The results obtained in detail in the Appendix and in summary can be seen in Table 16.

Table 16 Results of Assessment of Teaching Materials by Media Experts

Component	Index Average	Category
Cover	4	Very suitable
Layout	3	Suitable
Content	4	Very suitable

4.1.3.3 RPP Validation Results

The Learning Implementation Plan is validated by material experts to see the validity of the components of the lesson plan in the form of: 1) Formulation of indicators and learning objectives, 2) Materials, 3) Activities, 4) Learning resources, 5) Assessment. The results of the analysis carried out in general can be seen in Table 17.

Table 17 Results of RPP Assessment by Material Experts

Component	Index Average	Category
Formulation, indicators and learning objectives	4	Very suitable
Content	4	Very suitable

Activity	3	Suitable
Learning resources	4	Very suitable
Assesment	3	Suitable

4.1.3.4 Results of LKPD Validation

1. Material Expert Validation

The validation of LKPD by material experts is described in Table 18 and more details can be seen in the Appendix.

Table 18 Results of LKPD Assessment by Material Experts

Component	Index Average	Category
Didactics	4	Very suitable
Quality of LKPD material	4	Very suitable
Environmental aspects of Gong cave	4	Very suitable
Average	4	Very suitable

In the table above, it is found that the average value of all components is 4 and is in the very suitable category, so it can be concluded that the results of the material expert validation of the LKPD are valid and suitable for use.

2. Media Expert Validation

The validation of LKPD by material experts is described in Table 19 and more details can be seen in the Appendix.

Table 19 Results of LKPD Assessment by Media Experts

Component	Index Average	Category
Cover	4	Very suitable
Picture illustration	3	Suitable
Writing format	4	Very suitable

Activity content	4	Very suitable
Language	4	Very suitable
Average	4	Very suitable

4.1.3.5 Model Implementation Observation Instrument Validation Results

The results of the validation of the model implementation observation instrument were carried out by two learning experts, which in detail can be seen in the Appendix and briefly can be seen in Table 20

Table 20 Assessment Results of Observation Instrument for Implementation of Learning Model

Component	Average Value	Category
Sintaks	95.83333	Very high
Organising students to learn and formulate an action plan (concept consolidation) Concept and Action Plan	95.83333	Very high
Designing the Product (Performing the 4A Plan)	93.75	Very high
Assessing Potential	93.75	Very high
Social system	97.22222	Very high
Support system	93.75	Very high
Average	**95.02315**	**Very high**

Based on the table of the results of the assessment of the observation instrument for the implementation of the learning model, the results show that the average total score is 95.023 which is in the very high category. This means that based on the results of the assessment of learning experts, the observation sheet is declared feasible to use and an observation tool for the science cave environment learning model.

4.1.3.6 Validity and reliability of the model effectiveness questionnaire (creativity, confidence, and courage to take a stand)

A questionnaire was utilized to measure creativity, self-confidence, and willingness to take initiative. Empirical validation was conducted using the corrected item-total correlation to assess the correlation of each item's score with the total score and correct the correlation coefficient to address overestimation. The instrument is considered valid if the item correlation values are ≥ the standard (r ≥ 0.300) or ≥ the critical r-value (df = n-2). The analysis results indicate that the instruments measuring creativity, self-confidence, and willingness to take initiative are valid overall, with scores ≥ the standard (r ≥ 0.300). Reliability testing was performed using Cronbach's Alpha to evaluate the instrument's consistency. The analysis revealed reliability values of 0.727 for creativity, 0.796 for self-confidence, and 0.768 for willingness to take initiative. Therefore, the instruments are deemed valid and reliable.

4.1.4 Product Practicality Trial Results

The trial was conducted through two stages, namely, limited trial and extended trial. The limited trial was conducted on one group at SMKN Pringkuku with 35 students. After that, an expanded trial was conducted at SMKN Pringkuku and SMKN 2 Donorojo, each consisting of two groups, namely the control group and the experimental group. The total number of students in the control group consisted of 62 students and the experimental group consisted of 60 students.

4.1.4.1 Limited trial

1. Practicality trial of science cave environment learning model

Practicality trial was conducted by observing the learning process. The learning process was conducted for two meetings observed by two observers. The results of the observation of the practicality of the syntax of the science cave environment learning model can be seen in Table 21.

Table 21 Results of Observation of the Implementation of the Syntax Component of the Limited Trial

Syntax component	Score	Value	Category
Problem Stimulation (Problem Environment)	20	83	Good
Organising students to Learn and formulate an action plan (concept consolidation and action plan)	17	71	Enough
Designing the Product (Performing 4A Plan)	14	87.5	Good
Assessing Potential	12	75	Enough
	15.7	79.12	

Average	5	5	Enough

Based on the observation results in Table 21, it is found that the average value of the observation results is 79.125 with a sufficient category. In addition, the practicality category is determined based on the practicality of (Ismail et al., 2017) which is described in Table 22 below.

Table 22 Koyan Practicality Category

Value	Category
90-100	Very Practical
75-89	Practical
65-74	Practical enough
55-64	Less Practical
0-54	Very Less Practical

So, based on the average value data in the table of limited trial observation results, it is declared practical with an average value of 79.125.

Furthermore, an analysis was carried out on the social system of the science cave environment learning model. detailed observation results are attached in the Appendix and presented in Table 23.

Table 23 Results of Observation of System Component Implementation

Social System Components	Score	Value	Category
co-operation between students	81.25	81.25	Very good
interactive co-operation between students and teachers	68.75	68.75	Less
student co-operation in groups motivates students	81.25	81.25	Good
freedom of expression	87.5	87.5	Good
interactive discussion and interaction	93.75	93.75	Very Good
the teacher directs students to focus on			

the activity of analysing the gong cave environment	62.5	62.5	Less
learning resources are provided by the teacher together with students	100	100	Very Good
the teacher motivates students to design a product that has selling value	75	75	Enough
provide meaningful feedback	75	75	Enough
Average score	**81**	**81**	Good

Based on the data in Table 23, it is stated that the social system is implemented in the good category with an average score of 81. There are several categories that are lacking, namely 1) cooperation between students and teachers interactively, for example how to explain the benefits of learning: 2) Teachers need to further direct students to focus on analysing the Gong cave environment. The third observation result of the science cave environment learning model is the reaction principle. The results of further observations in the Appendix and summarised in Table 24.

Table 24 Observation Results of the Reaction Principle of the Limited Trial

Support System Components	**Score**	**Value**	**Category**
Using teaching materials resulting from the integration of 4A activity	15	100	Very high
Using the Science Cave lesson plan Environment	16	100	
Using the Science Cave Environment	16	100	Very high
Assessment is carried out through products, SWOT identification results, discussions, and self-assessment.	16	100	Very high
Average	**63**	**100**	**Very high**

2. Self-Reflection Results

Self-reflection is done at the end of learning, this observation is done to find out the usefulness, meaningfulness, and impression felt by students after doing activities on the science cave environment learning model.

Table 25 Limited Trial Learner Self-Reflection Assessment Results

No.	Statement	Percentage
1.	4A activities are useful for practising my skills	89%
2.	Enjoy working in groups	94%
3.	Conveying ideas and thoughts	89%
4.	Desire to learn more about rock craft	94%
5.	Desire to make creativity products at home	74%
6	Feeling confident about the product	74%
7	The activity of processing rocks around the cave is beneficial to the living environment and tourist attractions as well as local residents in increase interest	94%
8	Entrepreneurial desire of rock craft products	77%

3. Limited Test Results of the Effectiveness of the Science Cave Environment Learning Mode

The effectiveness test was conducted on a limited trial to see the effectiveness of the application of the science cave environment learning model. The trial was conducted using a quasi-experiment on the one-group pretest-posttest method. data analysis was carried out using spss, namely paired sample t-test at a significant level of 5%.

Table 26 Limited Test Normality Analysis Results

	Ability	Kolmogorov- Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
PretestScore	Creativity	.118	35	.200*	.955	35	.165

	Confidence	.114	35	.200*	.963	35	.290
	Courage to Take a Stand	.085	35	.200*	.945	35	.077
*. This is a lower bound of the true significance.							
a. Lilliefors Significance Correction							

Based on the results of the normality analysis of the pretest scores of creativity, self-confidence and courage to take a stand from the saphiro wilk analysis with a p>0.05 value. This shows that the students' data is normal. While the homogeneity test can be seen in Table 27.

Table 27 Results of Limited Test Homogeneity Analysis

		Levene Statistic	df1	df2	Sig.
Pretest Score	Based on Mean	1.821	2	102	.167
	Based on Median	1.767	2	102	.176
	Based on Median and with adjusted df	1.767	2	82.336	.177
	Based on trimmed mean	1.789	2	102	.172

Based on table 27 above, it is stated that the data taken is homogeneous with a significant value of 0.172>0.05. Furthermore, hypothesis testing was carried out with one sample paired t-test to see the effectiveness of using the learning model. The results obtained can be seen in table 28.

Table 28 Results of Limited Trial Effectiveness Analysis

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviatio n	Std. Error Mean	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper			
Pai	Creativity post test and pre	-	6.80546	1.1503	-	-	-	3	.000

r 1	test	10.25714		3	12.59490	7.91939	8.917	4	
Pair 2	Confidence post test and pre test	-9.97143	6.81040	1.15117	-12.31088	-7.63198	-8.662	34	.000
Pair 3	The courage to take a stand pre test and post test	-15.34286	8.11659	1.37195	-18.13100	-12.55471	-11.183	34	.000

The conclusion is drawn from the analysis results, where the basis for drawing conclusions is established on the significance level (sig. 2-tailed). If the probability value is > 0.05, H0 (null hypothesis) is accepted, and Ha (alternative hypothesis) is rejected. Conversely, if the probability value (sig. 2-tailed) is < 0.05, H0 is rejected, and Ha is accepted. The hypotheses are stated as follows: H0: there is no significant influence of the implementation of the science cave environment learning model on students' creativity, self-confidence, and willingness to take initiative in processing waste; Ha: there is a significant influence of the implementation of the science cave environment learning model on students' creativity, self-confidence, and willingness to take initiative in processing waste.

Based on the results, since the Sig value is < 0.05, Ha is accepted, and H0 is rejected. Therefore, it can be concluded that there is a significant influence of the implementation of the science cave environment learning model on students' creativity, self-confidence, and willingness to take initiative in processing waste.

4. Product Revision

The initial small-scale trial of the Science Cave Environment learning model identified specific areas for improvement. Recommendations include providing a more detailed explanation of the cave entry process during the first school meeting, emphasizing the benefits of the learning process, offering clearer guidance and motivation during SWOT discussions, and ensuring teachers master the teaching steps to instill confidence. These insights aim to reduce student queries during fieldwork and enhance overall understanding. The expanded trial, conducted in two locations with control and experimental groups, involves a total of 122 students. The comparison between the Science Cave Environment model and the Conventional Problem Stimulation method highlights the need for targeted enhancements in teaching steps and content delivery to optimize the learning experience.

1. Practicability trial of science cave environment learning model

The practicality trial was conducted by conducting observer observations of the learning process. The learning process was carried out twice a meeting observed by one observer in each school. The results of the observation of the practicality of the syntax of the science cave environment learning model can be seen in Table 29.

Table 29 Results of Observation of the Implementation of the Syntax Component of the Expanded Trial

Syntax Component	Score	Value	Category
Problem Stimulation (Problem Environment)	48	100	Very High
Organising students to Learn and formulate an action plan (consolidation) Concept and Action Plan	46	96	Very High
Designing the Product (Performing 4A Plan)	28	87,5	High
Assessing Potential	26	81,25	High
Average	131	91	Very High

Based on the observation results in Table 29, it is found that the average value of the observation results is 91 with a very high category. So it can be concluded that applied science learning using the Science Cave Environment learning model is carried out in accordance with the syntax that has been made and validated.

Table 30. Results of Observation of the Implementation of the Social System Component of the Expanded Trial

Social System Components	Score	Value	Category
cooperation between students	15	93.75	Very Good
co-operation between students and teachers in an interactive	15	93.75	Very Good

student co-operation in groups motivates students	13	81.25	Very Good
freedom of expression	13	81.25	Very Good
interactive discussion and interaction	15	93.75	Very Good
the teacher directs students to focus on the activity of analysing the gong cave environment	15	93.75	Very Good
learning resources are provided by the teacher together with students	14	87.5	Very Good
the teacher motivates students to design a product that has selling value	15	93.75	Very Good
provide meaningful feedback	16	100	Very Good
Average	**131**	**91**	Very Good

Based on the data in Table 30. it is stated that the social system is carried out in the excellent category with an average score of 91. So it is concluded that the social system is very well established by using the science cave environment learning model.

Furthermore, the reaction principle was analysed. The results of the third observation of the science cave environment learning model are in the Appendix and summarised in Table 31.

Table 31 Results of Observations on the Reaction Principle of the Extended Trial

Support System Components	Score	Value	Category
Using teaching materials integrated with 4A activities	15	93.75	Very High
Using the Science Cave lesson plan Environment	16	100	Very High
Using LKPD Science Cave Environment	16	100	Very High
Assessment is done through product assessment, SWOT identification results, discussion and self-assessment	16	100	Very High
Average	**63**	**98**	Very

			High

Based on the results of the analysis of the reaction principle in the pilot test, it was found that the average value of the supporting system components was stated to be very high with a value of 98.

2. Results of Self-Reflection

Self-reflection is carried out at the end of learning, this observation is carried out to find out the usefulness, meaningfulness, and impression felt by students after carrying out activities on the science cave environment learning model.

Table 32 Results of Assessment of Self-Reflection of Expanded Trial Learners

No.	Statement	Percentage
1.	4A activities are useful for practising my skills	87,1%
2.	Enjoy working in groups	93,5%
3.	Conveying ideas and thoughts	87,1%
4.	Desire to learn more about rock craft	93,5%
5.	Desire to make creativity products at home	71,0%
6	Feeling confident about the product	82,3%
7	The activity of processing the rocks around the cave benefits the living environment and tourist attractions as well as local residents in raising interest	93,5%
8	Entrepreneurial desire of rock craft products	79,0%

Based on the analysis results presented in Table 33, it can be concluded that the majority of students provided positive feedback regarding the 4A analysis activity in creating creative products. Approximately 87.1% of students found the activity beneficial for themselves, indicating a favorable reception of this learning approach. Moreover, the majority of students (93.5%) enjoyed group learning and collaboration, actively participating in discussions throughout the learning process. There is a strong inclination among students (93.5%) to further explore ways of waste management. While a significant percentage of students expressed confidence that their created products were appealing (82.3%) and beneficial for environmental cleanliness (93.5%), a considerable portion (79.0%) showed disinterest in becoming entrepreneurs. The main reasons cited by students were a lack of aspiration for entrepreneurship and a lack of experience in selling.

3. Limited Test Results of the Effectiveness of the Science Cave Environment Learning Model

The effectiveness test was conducted on a limited trial to see the effectiveness of the application of the science cave environment learning model. The trial was conducted using a quasi-experiment on the one-group pretest-posttest method. Data analysis was carried out using spss, namely paired samplet t-test at a significant level of 5%.

Table 33 Expanded Test Normality Analysis Results

	Code	Kolmogorov- Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Creativity	Control	.074	62	.200*	.967	62	.090
	Experiment	.052	60	.200*	.988	60	.812
Confidence	Control	.054	62	.200*	.987	62	.758
	Experiment	.093	60	.200*	.966	60	.097
Courage to Take a Stand	Control	.054	62	.200*	.985	62	.626
	Experiment	.133	60	.010	.886	60	.000

*. This is a lower bound of the true significance.

Based on the results of the normality analysis of the pretest scores of creativity, self-confidence and courage to take a stand from the saphiro wilk analysis with a p>0.05 value. This shows that the students' data is normal. The homogeneity test can be seen in Table 34

Table 34 Expanded Test Homogeneity Analysis Results

Test of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Creativity	Based on Mean	.280	1	120	.598
	Based on Median	.279	1	120	.598
	Based on Median and with adjusted df	.279	1	119.126	.598
	Based on trimmed mean	.288	1	120	.593

Confidence	Based on Mean	.060	1	120	.807
	Based on Median	.096	1	120	.757
	Based on Median and with adjusted df	.096	1	117.146	.757
	Based on trimmed mean	.073	1	120	.787
Courage to Take a Stand	Based on Mean	.001	1	120	.978
	Based on Median	.001	1	120	.979
	Based on Median and with adjusted df	.001	1	108.215	.979
	Based on trimmed mean	.000	1	120	.992

Based on the table above, it is stated that the data taken is homogeneous with a significant value of p>0.05. Based on the results of the homogeneity data analysis, it is stated that the sig. value of creativity is 2.79>0.05, which means it can be concluded that the variance of the creativity data of the control group and the experimental group is the same or homogeneous. Furthermore, hypothesis testing was carried out with one sample paired t-test to see the effectiveness of using the learning model. The results obtained can be seen in table 35

Table 35 Results of ANOVA Analysis of Expanded Trial Effectiveness

ANOVA						
		Sum of Squares	df	Mean Square	F	Sig.
Creativity	Between Groups	7.918	1	7.918	626.481	.000
	Within Groups	1.517	120	.013		
	Total	9.435	121			
Confidence	Between Groups	4.529	1	4.529	314.723	.000
	Within Groups	1.727	120	.014		
	Total	6.256	121			
Courage to Take a Stand	Between Groups	4.747	1	4.747	310.052	.000

	Within Groups	1.837	120	.015		
	Total	6.584	121			

Based on the results of the above analysis, the basis for drawing conclusions is that if the probability value (sig. 2-tailed) shows a value> 0.05 then H0 is accepted and Ha is rejected. Conversely, if the probability value (sig. 2-tailed) <0.05 then H0 is rejected and Ha is accepted. The sound of the hypothesis;

Ha: there are differences in creativity, confidence and courage to take a stand between groups taught science cave environment with groups taught with conventional learning models.

Ho: There is no difference in creativity, confidence and courage to take a stand between the group taught science cave environment and the group taught with conventional models.

Based on the results above, it is found that the Sig value <0.05 so that Ha is accepted and H0 is rejected. So, it can be concluded that there is an effect of applying the science cave environment learning model on creativity, confidence, and courage to take a stand.

5. Forms Of Activities Around The Cave That Students Do

The creation of creative products involves several steps, including selecting desired raw materials by choosing rocks around the cave that are no longer needed, designing the creative product, planning the creative product manufacturing process, and finally showcasing the saleable product made by the students. In the SWOT identification activity, students are trained to analyze the strengths, weaknesses, opportunities, and threats of the product they have created. This process involves evaluating the strengths and weaknesses of the product, assessing opportunities and obstacles that may be encountered when selling the product, and planning a business model or product exhibition based on the created product.

4.2 Product Revision

The development process of the science cave environment learning model involved several crucial stages. The initial product, tailored to meet the specific needs of applied science education in vocational high schools in Pacitan Regency, underwent validation by media and content experts, followed by limited and expanded trials. The iterative nature of the development process allowed for continuous improvements, leading to the transformation of the prototype model into the final model. Noteworthy revisions were made across various components, including the learning model book, teaching materials, lesson plans (RPP), worksheets (LKPD), and instruments designed to measure creativity, self-confidence, and the willingness to take action. Feedback from experts and educators played a pivotal role in refining these components. Suggestions ranged from simplifying language and improving sentence structures for better comprehension to providing more detailed explanations and guidance to enhance the overall effectiveness of the learning model.

Each component's revisions were targeted at optimizing the learning experience for both educators and students. The book model underwent enhancements suggested by media and content experts, emphasizing clarity and coherence. Teaching materials were refined for better student understanding and organized layouts. Lesson plans were adjusted based on educator feedback, ensuring detailed explanations and emphasizing the motivational aspects of the learning process. Worksheets were redesigned for simplicity and clarity, particularly regarding activities within the cave. Instruments for assessing students' creativity, self-confidence, and willingness to take action were validated and refined to enhance their relevance and effectiveness. These revisions collectively contributed to the development of a robust and effective science cave environment learning model that aligns with the educational goals of vocational high schools.

4.3 Final Product Review

This research addresses the need for the development of Applied Science education by leveraging the natural potential, particularly the richness of caves in Pacitan Regency, especially Gong Cave. Despite its significant potential, the underutilization and challenges in infrastructure, accessibility, and human resources around the cave are noteworthy. Therefore, the science cave environment learning model is developed with the aim of enhancing the creativity, self-confidence, and willingness to take action of students.

The integration of the science cave environment into Applied Science education serves as a solution to present extensive and often abstract materials effectively. Applied Science education in vocational schools emphasizes skills relevant to the workforce, making this model designed to combine Applied Science learning with the theme of utilizing the environmental ecosystem, specifically in Gong Cave. Thus, this learning model aims to provide more practical education and enhance students' readiness to face challenges in the professional world. So as to produce an integration model as shown in Figure 1.

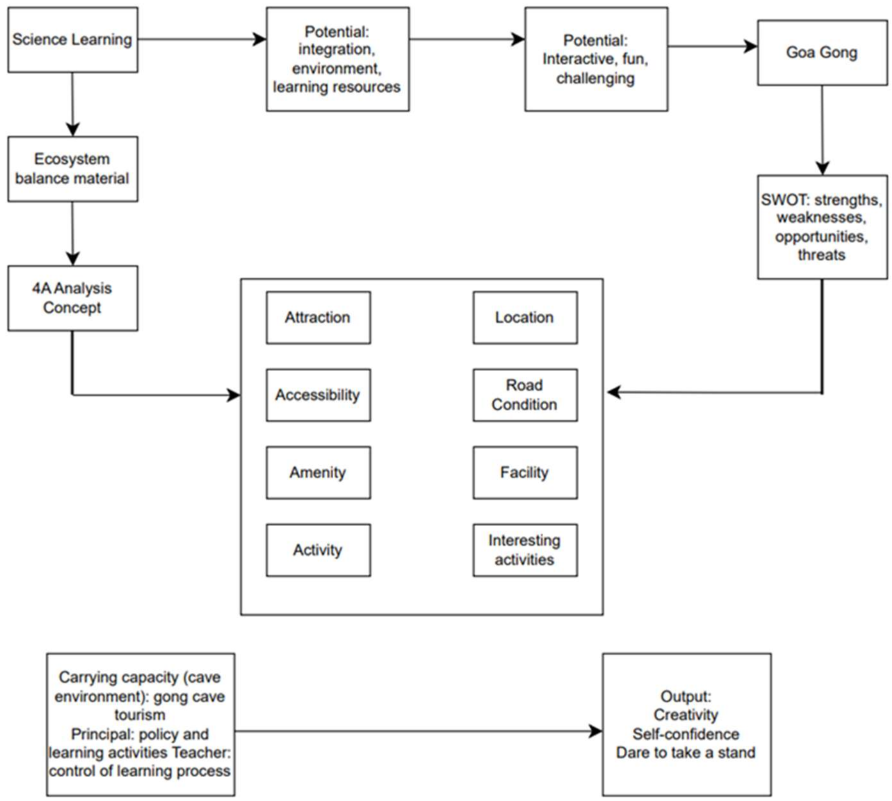

Figure 1 Flow of science learning integration with Science Cave Environment

Figure 1. shows that learning science learning resources are not only from books but can be utilised from the surrounding environment, one of which is a cave tourist spot, namely Gong cave. Gong cave can be one of the learning places that provides a unique ecosystem. Various things in the cave can be used as learning resources such as the shape of the stalactites and stalagmites, the sound that comes from the water flowing in the cave, and other rock components in the cave.

Gong cave tourism management is taught to students with the 4A concept of attractions, accessibility, amenity, and activities. through this concept, Gong cave tourism is introduced to students deeply and scientifically so that students' activities can be meaningful this concept. Gong cave tourism is introduced to students in depth and in science so that students' activities can be meaningful. In addition, students can also create a concept of utilising the cave ecosystem to improve facilities and the selling value of Gong cave tourism.

Science cave environment when translated means science in a cave environment. The meaning of the translation is science learning in the cave environment. This term is synonymous with the term the cave environment which is a term to indicate the cave environment and division of caves (Azhary et al., 2020) Besides being a tourist attraction, caves can also be used to learn science directly.

In the term the cave environment which is integrated with applied science learning, it means that learning is interpreted with attitudes and actions to use caves as learning materials and improve skills to face the world of work in the future.

Tourism actors began to take action to develop with research, observation of tourist objects in Indonesia. This step is taken to find out the potential and problems that exist in each object to then find a solution. Another step is promotion with print, electronic, and multimedia media so that people also know about the existence of these objects and participate in their development. objects and participate in their development (Saefullah et al., 2017)

One of the main skills of students at the SMK level in science learning is the ability to conduct SWOT analysis. SWOT analysis is a form of effort that must be made before starting a business. It requires the ability to recognise Strengths and Weaknesses and to see Opportunities and Threats that will arise in the future. Recognise strengths to be utilised to seize opportunities and suppress threats, and recognise weaknesses to avoid threats. After identifying these four things, the next step is to develop a strategy to achieve success.

The learning theme used in science cave environment is environmental ecosystem. The problem of the cave environment that is still minimally utilised and the lack of public awareness in the use of the environment is the basis for applied science learning with the application of 4A, namely, attractions, accessibility, amenity, and activities.

Accessibility is the availability of tourist access to a tourist destination so that it can be easily, comfortably, to get to the destination which can be in the form of transportation facilities, information, or geographical distribution of activities (McCurdy et al., 2013) Amenity refers to the basic facilities that tourists can use in tourist destinations with the aim of providing comfort, such as places that offer overnight stays to groups of tourists on a commercial basis as well as additional services that are the main destination attributes (Danielson, 2004) Ancillary services include all services provided to tourists that are usually not part of the original product. Thus, additional services can be classified as an additional part of tourism services (R. E. Mayer, 2012), so it can be said that the application and analysis of the 4A concept can be a guideline to help plan the development and management of a tourist destination in order to increase tourist interest in the destination (R. Mayer, 2020)

1. Structure of Science Cave Environment Learning Model

The development model was conducted to design a set of applied science learning procedurally. According to (Kraiger & Ford, 2021) education research and development is a process used to develop and validate educational products. This means that the main orientation of development research in the field of education is to develop a valid product, considered feasible if it has gone through a trial process. worthy if it has gone through the trial process and is considered to have a significant effect on the expected results. The structure of the learning model can be seen in Table 36

Table 36 Structure of Science Cave Environment Learning Model

Component	Description
Learning Sources	**Print:** Teaching Materials, LKPD **Audiovisual:** cave gong video **Environmental:** Gong Cave Tourism
Learning Activities	**Indoor:** listening to videos, brainstorming, understanding principles and concepts, planning products, identifying SWOT, concluding and self-reflection **Outdoor:** recording objects in the gong cave environment, selecting and sorting rocks, product design and product packaging.
Model Component	**Syntax**: 1) problem stimulation, 2) organising students to learn and formulate action plans, 3) designing products, 4) assessing and predicting SWOT, 5) process reflection **Reaction principles**: elaboration of the learning principles of Vygostky, Bruner, and Bandura Social System: the teacher as a mediator, motivator, and initiator (teacher-student), collaborative in building understanding **Support System**: videos, images, teaching materials, LKPD, assessment tools, (products, discussions, SWOT identification, self-reflection) **Impact**: 1) Instructional impact: concept understanding, craft skills, analytical skills, and self-reflection. 2) the accompanying impact: creativity, self-confidence, courage to take a stand in making craft products, meticulousness, diligence, and acceptance of friends' opinions. and accept the opinions of friends

Learning resources in this model consist of three types: print, audiovisual, and the surrounding environment. Print resources include validated teaching materials and worksheets (LKPD). Audiovisual media presents a video showcasing the Gong Cave tourist destination, providing insights for crafting designs and craft ideas. The surrounding environment, specifically the stalactite and stalagmite formations, as well as biotic components within Gong Cave, serves as an engaging learning resource for students.

The learning activities involve a blend of indoor and outdoor settings to stimulate student interest and combat monotony. This combination facilitates enhanced thinking activities and a closer connection to the actual environment. The model components include syntax, reaction principles based on Vygotsky, Bruner, and Bandura, social systems involving the teacher as a mediator, motivator, and initiator, and support systems such as videos, teaching materials, worksheets, and assessment tools.

The syntactic structure is designed around the SWOT analysis of the environmental ecosystem, supported by teaching materials and the availability of the Gong Cave environment in Pacitan. The learning activities encompass problem stimulation, organizing student learning and formulating action plans, designing products, SWOT identification, and self-reflection.

The reaction principles draw from Vygotsky's emphasis on social constructivism, Bruner's preference for self-discovery, and Bandura's social learning theory. The social system involves the teacher as a role model and guide, positioned based on the principles of Ki Hadjar Dewantara. The supporting system includes video, teaching materials, worksheets, and assessment tools.

The instructional impact of the science cave environment model encompasses skills in utilizing cave environments, discussion abilities, SWOT identification, and reflective skills. The accompanying impacts include teamwork, attentiveness, confidence, receptiveness to peers' opinions, and environmental problem awareness. The instructional focus neglects the affective domain, emphasizing cognitive and psychomotor assessments, aligning with the character of the science cave environment model emphasizing products and attitudes toward ecosystem issues.

2. Effectiveness of Science Cave Environment Learning Model

The Science Cave Environment learning model is designed to emphasize the development of creative and productive thinking in students, making them effective problem solvers in dealing with environmental issues in cave tourism sites. The activities involve analyzing the tourism site using the 4A approach (Attraction, Accessibility, Amnesty, and Activity) to evaluate the potential and opportunities in creating products using stones from the cave's surroundings.

The process includes discussions and collaboration to gather information and create creative products, allowing students the freedom to choose the type of product they want to make. Discussions are based on SWOT analysis, utilizing reflective and futuristic thinking. The results of students' self-reflection assessments show a positive response, emphasizing the benefits of learning, the desire to learn more, and an interest in entrepreneurship.The strengths of this model include a scientific design, an emphasis on the meaning and benefits of learning, group work training, experiential learning of environmental values, and freedom for students to be creative. Teachers need to consider several aspects, including selecting up-to-date videos, facilitating student knowledge, ensuring understanding of SWOT identification, and intensively communicating with students in groups to assist with difficulties, motivate, and enhance students' courage.

4.4 Development Limitations

The development of the science cave environment learning model is based on the spirit of innovation in developing learning into more interesting learning and can motivate students. In addition, the learning model was developed to teach students that applied science can be learned from any object, one of which is a cave. However, the research conducted has limitations from the development process carried out:

1. The science cave environment learning model is less suitable to be applied in areas far from cave tourism objects. Because the cave is the main object in this learning model.

2. Creativity, confidence, and courage to take an attitude that is used as a benchmark for assessment in the science cave environment learning model is not permanent because the assessment is carried out shortly after the learning has been carried out.

3. The products made have not been able to become actual entrepreneurial products, only as simple products made by students. A perfect product requires procedures carried out by professionals, so that to be sold commercially requires training and deepening expertise.

4. CONCLUSION

The Science Cave Environmen learning model, developed through a meticulous Research and Development (R&D) process, presents an innovative approach to Applied Science education, integrating environmental themes. This comprehensive model, guided by Borg & Gall's 10-step framework and incorporating instructional design principles, prioritizes creativity, self-confidence, and initiative. Rigorous validation by experts ensures its robustness, while practicality trials demonstrate a significant positive impact on students' creativity, self-confidence, and initiative. The model's final design, comprising a learning book, lesson plans, and assessment instruments, addresses the need for practical education in vocational high schools, particularly in areas proximate to cave tourism. Despite limitations, such as regional applicability and potential transience in assessing student attributes, the model's emphasis on fostering effective problem-solving skills in environmental issues makes a noteworthy contribution to vocational education. The researcher's commitment to innovation and the model's comprehensive development process underscores its potential as a valuable tool for enhancing student readiness for the workforce.

REFERENCES

Azhary, S. A.-G., Suryadarma, I. G. P., Devitasari, P. I., & Kuswanto, K. (2020). Development of Science E-Flipbook Integrated Illegal Sand Mining on River Basin to Improve Environmental Care Attitude. IJECA (International Journal of Education and Curriculum Application), 3(1). https://doi.org/10.31764/ijeca.v3i1.2036

Capron Puozzo, I., & Audrin, C. (2021). Improving self-efficacy and creative self-efficacy to foster creativity and learning in schools. Thinking Skills and Creativity, 42(October), 100966. https://doi.org/10.1016/j.tsc.2021.100966

Danielson, S. (2004). Work in progress - Ethics instruction for the workplace. Proceedings - Frontiers in Education Conference, FIE, 3. https://doi.org/10.1109/fie.2004.1408771

Ismail, M. A., Keumala, N., & Dabdoob, R. M. (2017). Review on integrating sustainability knowledge into architectural education: Practice in the UK and the USA. In Journal of Cleaner Production (Vol. 140). https://doi.org/10.1016/j.jclepro.2016.09.219

Isnandar, Ichwanto, M. A., & Ansyorie, M. M. Al. (2023). Sister-cousin TF model based on the influence of work preparedness and learning outcome. Social Sciences & Humanities Open, 8(1), 100722. https://doi.org/10.1016/j.ssaho.2023.100722

Kato, N., Arini, G., Silva, R. R., Bichuette, M. E., Bitencourt, J. A., & Lopes, N. (2024). The World of Cave Microbiomes: Biodiversity, Ecological Interactions, Chemistry, and the Multi-Omics Integration. Journal of the Brazilian Chemical Society. https://doi.org/10.21577/0103-5053.20230148

Kraiger, K., & Ford, J. K. (2021). Annual Review of Organizational Psychology and Organizational Behavior The Science of Workplace Instruction: Learning and Development Applied to Work. Annu. Rev. Organ. Psychol. Organ. Behav. 2021, 8.

Kulpa-Puczyńska, A. (2014). Teachers of Polish Vocational Schools vs. Changes in the Model of Employment and Organization of Work. Procedia - Social and Behavioral Sciences, 141, 969–975. https://doi.org/10.1016/j.sbspro.2014.05.166

Malik, A., Onyema, E. M., Dalal, S., Lilhore, U. K., Anand, D., Sharma, A., & Simaiya, S. (2023). Forecasting students' adaptability in online entrepreneurship education using modified ensemble machine learning model. Array, 19(July), 100303. https://doi.org/10.1016/j.array.2023.100303

Mayer, R. (2020). Science of Instruction: Determining What Works in Multimedia Learning. In Multimedia Learning. https://doi.org/10.1017/9781316941355.005

Mayer, R. E. (2012). The Science of Instruction: Determining What Works in Multimedia Learning. In Multimedia Learning. https://doi.org/10.1017/cbo9780511811678.004

McCurdy, S. M., Zegwaard, K. E., & Dalgety, J. (2013). Evaluating the development of science research skills in work-Integrated learning through the use of workplace science tools. Asia-Pacific Journal of Cooperative Education, 14(4).

Moldovan, L. (2012). Innovative Models for Vocational Education and Training in Romania. Procedia - Social and Behavioral Sciences, 46, 5425–5429. https://doi.org/10.1016/j.sbspro.2012.06.451

Mustapa, M. A. S., Ibrahim, M., & Yusoff, A. (2015). Engaging Vocational College Students through Blended Learning: Improving Class Attendance and Participation. Procedia - Social and Behavioral Sciences, 204(November 2014), 127–135. https://doi.org/10.1016/j.sbspro.2015.08.125

Nayak, G. H. H., Varalakshmi, A., Manjunath, M. G., Veershetty, Avinash, G., & Baishya, M. (2023). Trend Analysis and Prediction of Rainfall Using Deep Learning Models in Three Sub-Divisions of Karnataka. Journal of Experimental Agriculture International, 45(4). https://doi.org/10.9734/jeai/2023/v45i42114

Rott, K. J., Lao, L., Petridou, E., & Schmidt-Hertha, B. (2022). Needs and requirements for an additional AI qualification during dual vocational training: Results from studies of apprentices and teachers. Computers and Education: Artificial Intelligence, 3(April), 100102. https://doi.org/10.1016/j.caeai.2022.100102

Saefullah, A., Samanhudi, U., Nulhakim, L., Berlian, L., Rakhmawan, A., Rohimah, B., & El Islami, R. A. Z. (2017). Efforts to Improve Scientific Literacy of Students through Guided Inquiry Learning Based on Local Wisdom of Baduy's Society. Jurnal Penelitian Dan Pembelajaran IPA, 3(2). https://doi.org/10.30870/jppi.v3i2.2482

van Wijlen, A., Roelofs, P., & Finnema, E. (2023). The UMCG-Guild; a unique alliance regarding an innovative training course for nursing students in high complex clinical practice. Science Talks, 5(January), 100150. https://doi.org/10.1016/j.sctalk.2023.100150

Vit, E. (2023). The ability of low- and High-SES schools to inhibit learning losses during the COVID-19 pandemic. Social Sciences and Humanities Open, 7(1), 100393. https://doi.org/10.1016/j.ssaho.2022.100393

Yuan, Y.-H., Wu, M.-H., & Lee, J.-C. (2014). The Essential Difference on Public or Private Vocational School – The Student's Creativity of Mechanical Engineering. Procedia - Social and Behavioral Sciences, 116, 2321–2329. https://doi.org/10.1016/j.sbspro.2014.01.567