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Development of Subject Specific Pedagogy (SSP) Based on the Scientific Reading Based Project (SRBP) Model Empowering Critical and Creative Thinking Skills

Kartika C. Suryandari[1,*] Rokhmaniyah[1] Joharman[1]

[1] *Faculty of Teacher Training and Education, Universitas Sebelas Maret, Solo, Indonesia*
[*] *Corresponding author. Email: kartika@fkip.uns.ac.id*

ABSTRACT
This study aims to produce a Subject Specific Pedagogy (SSP) based on the Scientific Reading Based Project (SRBP) model of the Science Base Concept Course for empowering critical and creative thinking skills of Elementary Education Program students. This study uses research design development of Design-Based Research (DBR). The research procedure was adapted through four stages: a preliminary investigation, a development stage, a repetition/cycle stage, and a reflection phase. The research subjects were 120 students of Elementary Education Program students at Kebumen distric in semester 3 of 2018. Data collection techniques by interview, observation, questionnaire and test. Data analysis using mixed-method is descriptive qualitative and quantitative. The results of the study consisted of research-based learning tools in the form of syllabus, lesson plans, worksheets, and SRBP-based assessment models. Based on data analysis shows that the SSP based on the SRBP model is feasible and practical to empower PGSD students' critical and creative thinking skills. Research recommendations that the SSP based on the SRBP model can be applied to all levels of primary education to tertiary institutions on project subjects.

Keywords: *Subject Specific Pedagogy (SSP), SRBP Models, Critical Thinking, Students*

1. INTRODUCTION

The progress of science and technology, in addition to providing a variety of facilities, also requires sufficient skills to compensate. One effort to deal with the demands of the 21st century is to develop HOTs abilities or skills, namely creativity and innovation, critical thinking and problem-solving, communication, and collaboration.

Critical and creative thinking skills, such as two sides of a coin, are useful at the same time [1]. Critical thinking is convergent, while creative thinking is divergent, but the two are interrelated [2]. The ability to think can be divided into different types, namely logical, analytical, systematic, critical, and creative thinking. The ability of students to remember to conclude according to the rules of logic and conclusions that are true (valid) by recognized knowledge is called logical thinking. To empower critical and creative thinking skills, it takes the application of a project model, SRBP.

The SRBP model consists of 6 syntaxes, namely orientation, scientific reading, design of the project, progress of the project, analysis, discussion, and communication [3].

The SRBP model emphasizes the implementation of projects based on scientific reading or scientific articles [4]. Reading scientific articles is reading comprehension that requires the ability to study a text related to learning material. This is a contribution to learning, especially the development of critical and creative thinking

For the implementation of project learning, it is necessary to develop a SSP based on the SRBP model. SSP in the SRBP model consists of components (1) the syllabus; (2) Learning Implementation Plan (RPP); (3) The student Worksheet (LKS); and (4) assessment [6]; [7].

Subject Specific Pedagogy (SSP) based on Scientific Model Reading Based Project (SRBP)

Subject Specific Pedagogy (SSP) based on Scientific Model Reading Based Project (SRBP) is the packaging of learning tools used by lecturers when teaching. The SSP component consists of the Semester Learning Plan (SLP), Learning Implementation Plan, teaching materials for students, and assessment. Scientific Reading and Project-Based Learning Model (SRBP) is a model of teaching using projects and research in the learning process and based on area-based activities, based on a philosophical constructivist philosophy [8]. SLP is a plan that describes the procedures and learning management to achieve one basic competency set in the content standards outlined in the SLP [9].

The SRBP learning model is based on a constructivist philosophy that includes four aspects, namely learning that builds student understanding, learning by developing prior knowledge, learning, which is a process of social interaction and meaningful learning achieved through real experience [10]. The preparation of the SSP based on the SRBP model consists of six syntaxes, namely a) orientation, b) scientific reading, c) design and create, d) progress of project, e) analysis, f) discussion and communication [4].

Natural Science Learning for Students at Elementary Education Program

The ability to reason or think inductively and deductively is needed in learning the Basic Concepts of Natural Sciences. Science reflects everyday life, so that learning is meaningful and useful with "learning by doing" activities. The meaning of "learning by doing" in science learning is connecting real-life activities with science concepts [11]. Therefore, to teach science requires hands-on and minds-on activities and inquiry [12]. Science learning studies natural phenomena accompanied by facts/evidence involving students with constructivism, hands-on and minds-on cognitive activities so that learning is meaningful. Students are trained in developing process skills, critical thinking, and creative. Then science learning should be conveyed holistically by combining a theme.

Science is one branch of science that can develop skills in the 21st century [10]; [13]. Science must be viewed from four dimensions, namely science as a way of thinking, science as a way to investigate, science as the body of knowledge, science, and its interaction with technology and society. Therefore, in science learning activities must include these four dimensions to grow students in scientific literacy.

Critical and Creative Thinking Skills

Critical and creative thinking skills are a process of thinking of students in a higher cognitive level that is developed from various concepts and methods of cognitive and taxonomy of learning, such as project-based learning methods, problem-solving, and inquiry [14]. Critical and creative thinking of students will be able to distinguish ideas or ideas clearly, argue well, be able to solve problems, be prepared to construct explanations, be able to hypothesize, and understand complicated things to be clearer [15].

Thinking is a mental activity in solving problems. The SRBP model emphasizes the importance of high-level thinking, especially critical and creative thinking. The ability to think critically on aspects of analyzing, interpreting, drawing conclusions, giving explanations, evaluating, and self regulation [16]. The ability to think creatively on issues of originality, fluently, flexibility and elaboration [17].

The objectives of the study are 1) to analyze the characteristics of Subjects Specific Pedagogical in the subjects of the basic concepts of Natural Sciences to empower critical and creative thinking skills, 2) Analyze the feasibility of the SSP in the subjects of the basic concepts of Natural Sciences to empower critical and creative thinking skills.

2. METHOD

This research is a research and development that develops learning tools based on the Scientific Reading Based Project (SRBP) model to empower the critical thinking skills of pre-service teacher elementary education program. This development uses the Four-D model proposed by [18]. This model consists of 4 stages of development, namely, Define, Design, Develop, and Disseminate. The steps in this research include; (1) define stage: analyze the needs in the field and the difficulties of lecturers in planning science learning, (2) design stage: aim to make a learning tool based on the SRBP model by tracing relevant theoretical studies, (3) developing stage: aim to conduct the process of learning device validation based on the SRBP model. After validation, a revision process is carried out, followed by product evaluation through a closed questionnaire with a Likert scale conducted by practitioners such as model lecturers, heads of study programs, and colleagues. Furthermore, initial field trials, primary product revision or revision of the trial results are carried out, (4) the dissemination phase of the SSP based on the SRBP model to empower critical thinking skills [19]; [20].

2.1. Participants

The research subjects were students at Elementary Education Program in 2th semester of 2019, with 126 students consisting of 3 classes, and in 4th semester of 2018, 76 students were consisting of 2 courses.

2.2. Instrumentation

Research instruments in the form of observation sheets, questionnaires, and interviews. The learning tools

that will be validated are Semester Learning Plan (SLP), Learning Implementation Plan (LIP), Basic Science Concept teaching materials for student at Elementary Education Programs, test assessment, and performance assessment for performance.

2.3. Data Validity

The validation process is carried out by curriculum experts and model experts. Research data were analyzed qualitatively by experts, and construct validation data were analyzed quantitatively. The results of the validation are used as focus group discussion or Focus Group Discussion (FGD) involving model lecturers, peers, and researchers as resource persons. This activity aims to review the initial product, provide input or improvement. This validation process is called expert judgment [21]. Data from the assessment of the feasibility of the developed model are analyzed descriptively. Determination of the level of eligibility using the formula Aiken V. The coefficient of content validity of Aiken V to calculate the content-validity coefficient is based on the results of an expert's assessment of 6 people on an item to what extent it represents the measured construct.

2.4. Data Analysis

Data were analyzed, and practitioners and readability tests, which were still in the form of qualitative data were converted into scores according to the Likert scale. The use of ideality percentage (p) aims to make it easier to interpret the data from the assessment results and readability tests. If the analysis results are obtained, Very Good (SB) or Good (B) and Strongly Agree (SS) or Agree (S).

3. RESULTS AND DISCUSSION

3.1. Results

Based on the results of the study that the SRBP SSP model produces three main products, namely: 1) the general manual of SRBP models which are oriented towards critical and creative thinking skills, 2) Semester Learning Plan (SLP) and Learning Implementation Plan (LIP), 3) Basic Concepts learning modules Integrated Science for Elementary Education Program students who emphasize project activities based on the scientific reading. All products in the development of the SRBP model are synergistic, coherent, holistic, to empower critical and creative thinking skills (Table 1).

Table 1. Results of the SRBP model of expert learning appraisal

Component	Expert						*Validity Aiken's*	*Criteria*
	A	*B*	*C*	*D*	*E*	*F*		
Syllabus and RPP	3.66	3.66	3.67	3.33	4,00	3.67	0,88	Very valid
Modul KD.IPA SD	3.33	3.33	3.33	3.33	3.33	3.67	0,79	Very valid
SRBP model guide	3.80	3.60	3.80	3.60	3.60	3.80	0,90	Very valid
Evaluation	3.66	4,00	3.67	3.33	3.67	3.67	0,88	Very valid
Language	3.66	3.66	4,00	4,00	3.67	3.67	0,92	Very valid
Syllabus and RPP	3.66	3.66	3.67	3.33	4,00	3.67	0,88	Very valid

3.1.1. Semester Learning Plan (SLP)/ Syllabus

The learning device validation data obtained from each validator is tabulated for each component of the assessment items available in the research instrument. The SLP components assessed include learning outcomes, indicators, learning activities, learning objectives, and assessment. SLP assessment results with a score of 0.88 with very valid criteria. The SLP contains the SRBP model syntax, namely orientation, scientific reading, design of the project, progress of the project, analysis, discussion and communication. The expert gave a good general assessment with a slightly revised conclusion. Discussions with experts provide

recommendations so that learning objectives reflect C4 - C6 cognitive levels or cognitive levels.

3.1.2. Module Validation Results for the Basic Concept of Natural Sciences Based on SRBP Models

The components assessed consist of the appropriateness of the content, linguistics, feasibility of presentation, stimulating critical and creative thinking skills. The assessment result with a score of 0.79 means it is very valid (Table 1). The results of discussions with material experts reviewed from Physics, Chemistry, Biology provide several recommendations for the appropriateness of contents for the breadth and depth of the material to be clarified to be more thematic that connects the concept of integrated science, using a standard language, the syntax position of the SRBP model integrated into the module is clarified to improve critical thinking and creative.

The Basic Concept, Science module section, consists of the beginning, contents, and end. The initial part includes (a) cover page: contains the title, author, cover image, department name, book target and year of publication, (b) copyright sheet, (c) foreword, and (d) table of contents.

Based on the assessment of 3 experts, the researchers made improvements, among others: (a) Modules were given material maps to limit the understanding of integrated science concepts being studied, (b) Learning materials foster curiosity by presented several pictures about the phenomenon of science accompanied by some questions. (c) The module contains reading resources, abstracts of scientific articles, and keywords along with a website address that can be accessed and reviewed by students online. (d) Language eligibility to use standardized sentences in accordance with Enhanced Spelling, straightforward, communicative language, and operational verbs that involve students in critical and creative thinking. (e) Invitational sentences motivate students to respond to messages and create interactive communication. (f) Changes to the appropriateness of the presentation, the researcher make an effort to provide accuracy between illustrations and material by displaying documentation, not taking pictures online from Google but personal literature. (g) The module contains six SRBP model syntaxes with more communicative sentences to engage students in critical and creative thinking. (h) The module is accompanied by an evaluation and answer key, (i) the end of the module material is equipped with a glossary.

The preparation of the SRBP model prototype was then validated by the model expert. The results of expert validity show that the SRBP model is valid and reliable, with a mean score between 0.90 (Table 1).

After being validated by the expert, it was recommended to (1) deepen philosophical studies relevant to the SRBP model and improve writing. (2) Deepen philosophical studies, ontologically, epistemologically, and axiologically adjusted to the characteristics of the SRBP model. (3) provide a more detailed explanation of the structure of the SRBP model, mainly on the syntax aspects. (4) the grading system is more accurate by making rubrics.

3.1.3. Evaluation and Assessment

Content evaluation and assessment with a score of 0.88, which means it is very valid. An authentic evaluation system by measuring the evaluation process to measure performance, achievement, motivation and student attitudes on activities relevant in learning the Basic Concepts of science. The SRBP model's authentic assessment as a way of giving assignments to students reflects the priorities and challenges found in learning activities such as researching, writing useful reports, revising and discussing articles, evaluating projects, analyzing them orally, collaborating with fellow students through discussion.

Feasibility in terms of language with a validation value of 0.92, which means it is very valid (Table 1). Indicators of language assessment include a) the accuracy of sentence structure, effectiveness, terms, b) communicative, c) dialogic and interactive, d) compatibility with the development of the learner, the harmony and the integrity of the channel, and the use of symbols.

3.1.4. Results of Empirical Validation on Critical and Creative Thinking Skills

Assessment of critical and creative thinking skills test questions is based on concepts and indicators that have been consulted with experts. Based on expert advice, revise the matter's order to make it clearer, drawings/graphs/tables are improved according to questions, data from questions based on research, or scientific articles. Differences in critical thinking skills between the experimental and control groups (Table 2).

Table 1. N-Gain scores aspects of critical and creative thinking

Aspect	Groups		
	SRBP	*Cohort*	*F*
	N-gain	*N-gain*	
Interpretation	0.28	0.25	7,84
Inferension	0.20	0.17	
Analysis	0.24	0.27	
Explanation	0.25	0.24	
Evaluation	0.26	0.21	
Self regulation	0.28	0.34	

Based on Table 2, the ability to think critically on aspects of interpretation, inference, analysis, explanation, and evaluation with low N-gain scores is between 0.17 - 0.34. F calculated 7.84 and a significance of 0,000. This figure shows a significant difference between the experimental and control groups. N-gain with a score of 0.70 <g <1.00 in the high category, 0.30 <g <0.70 in the medium category, 0.00 <g <0.30 in the low category [2]. The main impact of Creative Thinking Skills

Table 3. N-Gain score aspects of creative thinking

Aspect	Groups		
	SRBP	*Cohort*	*F*
	N-gain	*N-gain*	
Elaboration	0.28	0.23	7,84
Fluently	0.30	0.27	
Flexibility	0.34	0.27	
Originality	0.35	0.24	

Based on Table 3, the ability to think about the aspects of elaboration, fluently, flexibility and originality with low N-gain scores is between 0.23 - 0.27. F count 9.50 and significance 0.000. This transportation shows a significant difference between the experimental and control groups with the moderate category.

3.2. Discussion

The SRBP model product was developed based on the needs of students and lecturers aimed at achieving the empowerment of critical and creative thinking for PGSD students. The SRBP model is in line with the concept of Technological Pedagogical Content Knowledge (TPCK) that mastery of the material, learning methods, and ability of technology work together to produce meaningful learning [23]; [24]. The SRBP model is very feasible to implement in terms of conceptual validation and construct validation. The feasibility of the teaching material is following Permenristek Dikti Number 44 of 2015 concerning Higher Education National Standards on the standard process that the learning characteristics are interactive, collaborative, holistic, scientific, contextual, thematic, practical, and student-centered. This feasibility is strengthened by research [12]. The essence of learning The Basic Concepts of Science are inquiry, contextual, and findings that are relevant in everyday life. The SRBP model contains clear ontology, epistemology, and axiology studies. The specific objectives of the SRBP model empower critical and creative thinking skills. The SRBP model contains five-component model requirements, namely syntax, social system, reaction principle, support system, main impact, and accompaniment. The uniqueness or novelty of the SRBP model is that the project is based on scientific reading, which is student-centered, emphasizing the concept of heutagogy [25]. This is following the nature of project-based learning where students take over responsibility [4]; [6].

Scientific reading is the ability of students to read understanding in scientific articles or research journals. Reading skills are skills that are continuously trained to understand each sentence. Reading is a process of developing skills ranging from understanding each symbol, word, sentence, paragraph to understanding the entire reading critically. Reading scientific articles is not as easy as reading a newspaper or magazine that, at a glance, the reading content can be understood. Reading scientific articles must be repeated, analyzed, made their own questions, asked questions, summarized, and evaluated [7]; [11]. Likewise, reading influences creative thinking to find unique and detailed ideas. Thinking skills consist of four levels: a) memorizing / recall thinking is the lowest level of thinking, automatic and possessed by everyone, b) basic thinking includes understanding concepts, c) critical thinking to solve problems in analysis, evaluation and generalization d) thinking Creative thinking is to develop ideas and ideas [16];[23]; [25].

4. CONCLUSION

Characteristics of the Scientific Reading Reading Project (SRBP) model emphasize project activities based on scientific articles or research journals, which have 6 learning syntax consisting of a) orientation, b) scientific reading, c) design of the project, d) progress of the project, e) analysis and f) discussion and communication. The feasibility assessment after content validation by six experts and construct validation (the relevance and consistency of all components of the model) shows that the SRBP model and its completeness are valid and very

feasible to be applied in learning. The SRBP model guide components, including Syllabus, RPP, and evaluation, get high scores, which means they are very supportive of empowering critical and creative thinking skills.

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