ISSN: 2345-0479 / eISSN: 2345-0487

VILNIUS TECH
Vilnius Gediminas Technical University

CREATIVITY STUDIES

2024
Volume 17
Issue 2
Pages 419–434
https://doi.org/10.3846/cs.2024.16302

THE EFFECT OF PROBLEM-BASED LEARNING ASSISTED WITH CONCEPT MAPPING FOUNDED ON COGNITIVE STYLE ON THE CREATIVITY OF WRITING EXPOSITION TEXT

Rubiah RUBIAH ✉, I Nyoman Sudana DEGENG, Punadji SETYOSARI, Dedi KUSWANDI

Department of Education Technology, Faculty of Education, State University of Malang, Jl. Ambarawa No. 5, 65145 Sumbersari, Kec. Lowokwaru, Malang, East Jawa, Indonesia

Article History:
- received 14 January 2022
- accepted 22 June 2024

Abstract. The aim of this research is to obtain another point of view with collaborative problem-based learning to increase writing creativity in the field of scientific work in the form of exposition text by investigating cognitive style as an individual character and using concept mapping media. This study uses descriptive research methods and multivariate analysis is used to provide a clear picture of writing creativity that considers the use of learning methods, concept mapping media, and students' cognitive style backgrounds. The research subjects were students of the second-semester Islamic religious education study program from the Islamic Senior High School Diniyah Putri Pekanbaru, Indonesia. Sample selection was done by means of cluster random sampling. The sample was divided into two, the experimental class which collected 30 people, and the control class with a number of 30. The cognitive style must be considered in the application of the learning method. Students with field-dependent cognitive styles are more adaptable in collaborative learning. The use of media mapping to foster writing creativity was evident during the research. Concept mapping, which involves higher-order thinking skills, stimulates students to continue to involve the imagination in their creative process. Several educational implications are discussed and can be used as future research directions. The interpretation results are obtained by considering the relevant literature findings.

Keywords: cognitive style, concept mapping, creativity in writing, expository writing creativity, problem-based learning.

✉Corresponding author. E-mail: ***rubiahkita@gmail.com***

1. Introduction

The active role of students in the implementation of learning needs to get support from all parties, parents, teachers and students. They are a major factor in completing their academic assignments. Without interaction, cognitive resources, and individual motivation can affect the implementation of learning and performance (Bråten et al., 2022). On the other hand, when these resources become operational in the implementation of learning through involvement in relevant learning tasks, the true competencies of students can be revealed and even tasks that were previously considered out of reach can be revealed (Bråten et al., 2022). Resources can be utilized by using media that can increase understanding of the problems experienced by students. Utilization of resources in problem-solving can bring the actual situation and environment closer to direct experience (Suryanto et al., 2021a).

Utilization of resources by using mind mapping learning media can trigger the emergence of ideas. Learning activities in Indonesia that do not involve creativity and experience in problem-solving, students' abilities in creative aspects are low. So that Indonesia is ranked 2nd

out of the bottom 81 of 82 countries (Suryanto et al., 2021a). Cultivating creativity in writing requires media that can make them see something that encourages them to write something. By using the concept of mapping, students get an overview of the circumstances, forms, and situations that are close to the real situation so that they can improve their thinking skills (Jász, 2018; Silberman, 1996). Such a situation encourages researchers to produce new views on writing creativity in students. Writing is a cognitive skill that involves all domains (Finn, 2019; Stagg Peterson et al., 2018; Suryanto et al., 2021b). Writing an exposition requires creativity in formulating problems and finding ideas related to the topic to be discussed. To facilitate this, concept map media is needed to formulate the flow of learning objectives starting from identifying problems, formulating problems, conveying ideas and finding new solutions to the topics discussed. In order for the creative process to occur during the learning process, it is necessary to pay attention to students' cognitive styles so that the flow of learning objectives in an effort to develop creativity through learning activities can run optimally. Using adopting the flow of creative writing learning objectives with the theme of expository writing, it can be applied to second semester students of the Islamic religious education study program and Islamic Senior High School Diniyah Putri Pekanbaru (ISHSDPP). Some students' initial references still have limitations in developing creativity through conveying ideas and solving problems in writing. The aim of this research is to explore the application of problem-solving methods assisted by concept mapping which is moderated by cognitive learning styles in the creativity of writing scientific papers in exposition form. The expected contribution in the future is to provide an alternative route for implementing the use of concept map media which is moderated by cognitive style in creative writing through PBL experiences in finding creative ideas and solutions in writing scientific papers in the form of expositions. Therefore, we tested a model in which differences in previous exposition writing topic knowledge, cognitive style, and the use of concept map media on writing creatively indirectly influenced student performance and productive effort when working on writing assignments.

2. Literature review

2.1. Problem-based learning

Problem-based learning (PBL) is rooted in the educational principle adopted by John Dewey, namely "learning by doing". Dewey's (1997) point of view uses the school as a laboratory to solve real-life problems of students (Glaveanu et al., 2013; Schenkels & Jacobs, 2018). The problem-solving process fulfils the five stages of Dewey's (1999) theory, namely recognizing the problem, defining the problem, collecting several solutions, predicting the consequences of the problem-solving solution, and testing or evaluating the solution. The definition of PBL is

> "Learning strategies to empower students to pursue their own content knowledge and demonstrate their new understanding through a variety of exploring information, defining problems, conveying ideas and finding solutions" (Dewey, 1999; Glaveanu et al., 2013).

The concept of PBL is

> "Problem solving learning uses authentic real world problems, based on questions, tasks, or problems that are highly motivating and interesting to teach academic

content to students in the context of working together to solve problems" (Glăveanu, 2018; Paek, 2019; Suryanto et al., 2021a).

An individual who has difficulty building his cognitive model will have difficulty building his thinking skills, not doing the problem-solving process well. According to cognitive psychologists, mental models represent internal scale models of external reality or a person's mental representation of an idea or concept (Thompson et al., 2019). PBL has the potential to change students' thinking models. Creating learning situations can further enhance students' actual experience of learning through students' mental models.

This type of learning through project implementation is called project-based learning (Frenchs, 2012; Lavie & Sfard, 2019; Suryanto et al., 2021b). The PBL method involves students in authentic tasks and real-world contexts, to improve their learning and life skills in solving problems (Dewey, 1944). Students are given a project or problem in which there are many ways to solve it, which aims to stimulate a real situation. PBL begins with setting goals, creating a product, and introducing who the audience is.

The new experience is not only oriented to mental models but also thinking skills or what are called creative thinking skills. This is an important skill for solving problems in an era of openness. These skills are interpreted as the ability to offer new perspectives, generate new and meaningful ideas, ask new questions, and generate solutions (van Laar et al., 2019). The learning model that focuses on group learning activities solve problems or cases and encourage students to think with their knowledge, identify needed information, find more relevant information, and analyze and evaluate to build problem-solving paths.

Solving this problem begins with the task of writing a project-based exposition text starting with choosing a title, concept and writing procedure to be completed. The freedom to choose a theme in writing an exposition text is expected to foster their creativity towards themselves and their environment.

2.2. Concept mapping

Concept mapping is a graphical tool for organizing and representing knowledge. Concepts are summarized in a kind of circle or square and between these concepts are drawn with a line connecting the two concepts. Students are still lacking in creating independence in learning during learning, the presentation of material is still dominated by the teacher. In contrast, students have not found a good way of learning. Students feel confused to develop their conceptual framework. Concept maps provide an overview of the flow of problem-solving and links between existing concepts. Concept maps are tools or methods that teachers can use to find knowledge that students already know (Demetriou et al., 2017; Gwiaździński et al., 2020). Based on learning theory (Ausubel & Fitzgerald, 1961), teachers must understand the concepts that students have to learn meaningfully (Aluri & Fraser, 2019; Forthmann et al., 2019). In the application of meaningful learning, new knowledge must be associated with concepts that already exist in the cognitive structure (brain) of students. If there are no related concepts in the cognitive structure, then the new knowledge that has been learned is only a memory. Students make a thinking effort to understand complex systems and construct appropriate thought representations to model and explain these systems. Students continuously modify

and rearrange their thinking skills in every new experience, especially after the learning process. Conceptualization is a flow of thinking by identifying important points to be discussed. Understanding the flow of goals stimulates creativity in exploring information, finding ideas and finding solutions. If concept maps are used to improve high-level skills in the form of creativity, then concept maps will become a guide through the flow of thinking with concept maps. Writing exposition requires creative thinking skills and this is in line with the use of concept map media.

Besides being used in the teaching and learning process, concept maps can also be used for various purposes, namely: a) learning what students already know; b) learning how to learn; c) finding, and d) as an evaluation tool. Concept maps are used to express meaningful relationships between concepts in the form of a proposition (de Oliveira Sousa et al., 2020; van Wart et al., 2020). Propositions are two or more concepts placed before words in a semantic unit. In its simplest form, a concept map can be in the form of two concepts made with a connecting tool to form a proposition. For example: "The sky is blue" represents a simple concept map, which becomes an effective proposition about the concepts of "sky" and "blue". Therefore, students can arrange the concepts of the subjects studied according to the relationship between the meaning and its components. The relationship between one concept (information) and another is called a proposition. Concept maps describe the relationship between the concepts discussed in the chapter related to the concepts expressed in terms of concept labels (Demetriou et al., 2017; Amorim Oliveira et al., 2013). Concepts and conjunctions are meaningfully related to each other so that they can form propositions. A proposition contains two concepts and a conjunction. One concept has a wider scope than other concepts (Kahn, 2020). In other words, one concept is more inclusive than another. The overall concept is arranged hierarchically from the most general concept, the less general concept to the most specific concept. The levels of this concept are called hierarchies. The concepts that have been formed with students can bring out creativity in the form of new perspectives, ideas, and ideas that are meaningful. Students also become independent learners (Giza, 2021).

Concept mapping is one of the alternative learning strategies that can be chosen to improve the quality of education and student creativity. This learning strategy was initially developed in scientific fields such as biology, physics, or chemistry, and support. Concept mapping is a technique that externalizes concepts and propositions (van Wart et al., 2020; Williams et al., 2016). This conception mapping can also be applied to reading to help understand the text (Frenchs, 2012; Gandolfi et al., 2021). The text consists of parts of the text that are interconnected. If explained further, each section also includes smaller and more coherent sections. Reading activity is understanding the relationship between various parts of the text so that the reader can get a complete picture of the content of the text. Concept mapping not only helps to understand written texts but also helps to understand literary books such as novels. Therefore, a concept map is a special graphic description that shows how a concept is related to another concept in the same category.

Understanding concept maps, the characteristics of concept maps are as follows: (a) concept maps are a method of presenting concepts and propositions in the field of research. By using concept maps, students can see the research area more clearly and study it more

meaningfully; (b) the concept map is a two-dimensional description of the research field. This feature can show the proportional relationship between concepts; (c) not all concepts have the same weight. This means that there are concepts that are more inclusive than other concepts; (d) when two or more concepts are described under a more inclusive concept, a hierarchical structure exists in the concept map (Gwiaździński et al., 2020; Kahn, 2020). Based on this, concept mapping should be arranged hierarchically, which means placing more inclusive concepts on the map and placing fewer, less inclusive concepts. Student experience in presenting concepts, and showing proportional relationships between concepts is a skill that is interpreted as the ability to offer new perspectives, generate new and meaningful ideas, raise new questions, and generate solutions. These skills need to be utilized to help individuals find solutions to solve problems. The ability to think creatively is useful in dealing with various problems in the era of globalization.

The concept map method is used to uncover problems in designing expository text-writing project plans. This project-based learning process provides freedom to express problems in designing project plans. The creativity in selecting titles, concepts, and writing procedures is of course very varied, and concept maps are used to regulate the procedures for writing exposition texts. The use of concept maps is also used to write down some important points in exposition writing which will later be useful for developing material writing. The concepts that have been formed with students can bring out creativity in the form of new perspectives, ideas, and ideas that are meaningful. Students also become independent learners (Giza, 2021).

2.3. Cognitive style

Everyone has different characteristics in problem-solving ability, thinking ability, and application ability, one of which is cognitive style. Cognitive style is a consistent and enduring individual characteristic that uses cognitive functions (thinking, remembering, solving problems, making decisions, organizing and processing information, *etc.* (Suryanto et al., 2021a). Cognitive style is an important position in the learning process. Even cognitive style is one of the learning variables that need to be considered in designing learning. As one of the variables, cognitive style can not only reflect the characteristics of students, but also other characteristics such as motivation, attitudes, interests, thinking abilities, and so on (Bechara et al., 2000; Leikin et al., 2020). Cognitive style is an important position in the learning process. Even cognitive style is one of the learning variables that need to be considered in designing learning. As one of the variables, cognitive style can not only reflect the characteristics of students, but also other characteristics such as motivation, attitudes, interests, thinking abilities, and so on (Morales-Martinez et al., 2015, 2020).

Cognitive style is one of the new ideas in developmental psychology research and pedagogy. This idea was developed in research on how individuals receive and organize information from their environment. The results of this study indicate that individuals differ in how they complete the experiment, but these differences reflect certain levels of intelligence or patterns of ability. they do this in a preferred way, that is, individuals who have to process and organize environmental information and facts (Yeonjoo Lee et al., 2019; Potměšilová & Potměšil, 2019; Suryanto et al., 2021a).

Cognitive style is the way a person receives and organizes information from the world around him, besides that cognitive style is divided into independent and dependent fields (Kulophas et al., 2015). The characteristics of individual domain independence are: 1) focus on curriculum; 2) focus on facts and principles; 3) rarely interact with teachers; 4) only interact with teachers and commit to assignments. And tend to choose awards individually; 5) likes to work alone; 6) likes competence; 7) able to organize information independently (Potměšilová & Potměšil, 2019; Reindl et al., 2020).

Students with field-independent cognitive styles can learn to the fullest, including 1) providing learning in a personal learning environment; 2) providing more opportunities to learn and discover concepts or principles; 3) providing more resources and degree materials; 4) just provide some guidance and learning objectives; 5) prioritizing personal guidance and goals; 6) provide opportunities to summarize the model or concept map according to their ideas (Arends, 2012; Eliot & Hirumi, 2019). Individual indicators that are field-dependent and field-independent are as follows: 1) when the task is carried out or solving a problem, if the independent person is released it will work better. And if a field-independent person gets additional guidance or guidance then he or she will work better; 2) individuals with independent domains tend to be less sensitive to the environment, on the other hand, individuals with independent domains tend to be more sensitive to the environment (Arends, 2012). When solving or solving problems that require skills, a person who is independent of the spot will produce better results than a person who is dependent on the place.

Cognitive style measurements are carried out before problem-solving activities are carried out with the aim of knowing the cognitive style of each individual. In this research practice there is no grouping of students who have certain cognitive style characteristics. Cognitive style becomes a certain variable related to student characteristics. In practice this learning becomes one of the factors in the selection and application of learning methods and media. The research considers cognitive style as one of the variables in writing expository texts, because creativity is an important individual student skill in gathering information, formulating problems, finding ideas and finding solutions.

2.4. Writing skills

Writing is a thought but instead of thinking for a certain reading and for a certain time, the most important thing is mastering the principles of writing and thinking to achieve goals and objectives (Hembrough, 2020). Writing skills will not be formed only with language skills, but also need to be supported by reasoning skills and knowledge of basic rhetorical (Anderson & Krathwohl, 2001; Roeser et al., 2024). Arousing students' interest in writing can be started by stimulating efforts to respond to questions on the working paper, according to the explanation they understand about what is being developed. Whatever argument they write is the first step for their writing activities. The teacher's efforts so that students dare to come up with ideas, something that blocks their curiosity, and they can see it in writing form (Suryanto et al., 2021a). This technique is carried out at the beginning of the delivery of material related to writing. Various students' abilities in expressing ideas, concepts, and writing procedures require practice and habituation in class through learning activities. Therefore, good innovation is needed by applying a PBL model so that it can empower students'

problem-solving abilities and creative thinking abilities. By studying problem-solving, it gives students direct experience in writing scientific papers in the form of expository texts so that they can improve students' skills in writing expository texts in the form of scientific works. The term exposition comes from the word *expose* which means to provide an explanation or analysis. As an expository text, it is an informative or knowledgeable essay that is concise, clear, concise and interesting to read (Sieck & Yates, 1997). It is hoped that the use of concept map media can be utilized in the creative process of scientific work in the form of exposition writing. Using concept maps to develop important points in writing expository texts. Creativity in writing begins with creating a concept map to facilitate the flow of writing scientific work in the form of an exposition. The positive exposition effect requires the influence of an alternative frame on the choice of subject to be chosen for certain reasons because of the demands of the exposition. Therefore, the ability to develop relationships between concepts is greatly influenced by students' cognitive styles and this requires creativity in every process that occurs. In many cases it has been shown that, individuals differ in the way they complete experiments, but these differences reflect a particular level of intelligence or pattern of ability. This difference is influenced by their cognitive style. Concept maps are a medium to help students plan the flow of writing and make connections between concepts that are influenced by cognitive style.

3. Method

3.1. Participants

The research design uses a quasi-experimental design and a multivariate analysis test, which can be seen in Table 1 which is used to provide complete information about writing creativity by considering the use of learning methods, concept mapping media, and students' cognitive style background (Figure 1).

The subjects of this study were second-semester students of the Islamic religious education study program from ISHSDPP. Sample selection was done by means of cluster random sampling. The sample was divided into two, namely the experimental class with 30 people and the control class with 30 people. The average age of students studying is 19 years. The experimental class consisted of 18 male students and 12 female students. There were 16 male students and 14 female students in the control class. Before conducting the PBL experiment,

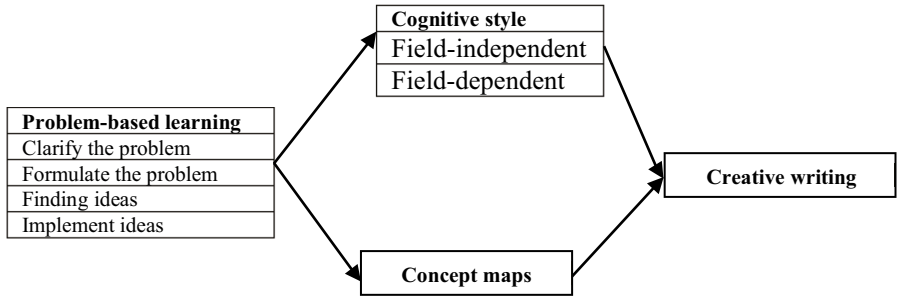

Figure 1. Research flow (source: created by authors)

a learning style test and creative thinking skills instrument were first carried out. The sample selection was carried out by means of cluster random sampling. The sample was divided into two, namely the experimental class of 30 people and the control class of 30 people.

3.2. Data analysis

Researchers used multivariate analysis to determine the relationship between students' social skills and creativity in writing scientific papers in the form of expository texts in class in solving problems with the help of concept maps and learning styles. The final results of data analysis are used to determine the results of implementing project-based learning using concept map media and moderated by the style of writing scientific papers in the form of exposition text. The relationship between elements can be seen in Table 2.

The research data was tested statistically using descriptive analysis techniques and two-way multivariate inferential statistical analysis of variance. Researchers used multivariate analysis of variance to determine the relationship between the application of PBL and the use of concept map media moderated by learning style on creativity in writing scientific papers in the form of exposition text. Based on the factorial design, the two classes represent the four defined treatments. The research subjects in the experimental class who were taught using project-based learning assisted by concept mapping and project-based learning without the aid of concept mapping as a control class both consisted of students with field-independent and field-dependent cognitive styles. Thus, every criterion in the factorial design column can be met. Data on the number of students who participated in this study, which consisted of two treatment groups, can be seen in Table 2.

Table 1. Connections between elements (source: created by authors)

Scientific work in exposition form	Problem-based learning	Creative process	Concept maps	Decision making
Determine the topic	Clarify the problem	Digging information	Connecting information	Field-independent
	Formulate the problem	Formulate the problem		Field-dependent
Find facts	Finding ideas	Convey ideas	Clarifying ideas	Field-independent
	Implement ideas	Found a solution		Field-dependent

Table 2. Research subjects (source: created by authors)

Learner's cognitive style	Without the help of concept mapping	Assisted by concept mapping	Total
Field-independent	24	21	45
Field-dependent	6	9	15
TOTAL	30	30	60

3.3. Data collection

The researcher collected data from the two research groups to test the differences. The first data collection was obtained by giving cognitive style tests and writing skills essay tests to the two research groups before being given, while the second data collection was obtained by giving back-tests to both groups after the treatment was given. Writing creativity data collection was measured using the following instruments (Table 3).

Table 3. Instruments for creative writing (source: created by authors)

Number	Indicator	Domain
1	Able to make correct spelling starting from diction level to discourse	Cognitive
2	Able to make sentences that can convey information precisely	Cognitive
3	Able to write paragraphs that can convey ideas precisely	Cognitive
4	Skilled in using spelling in composing sentences and paragraphs so as not to cause confusion	Psychomotor
5	Able to obey the general rules that apply in the spelling system	Affective
6	Be able to find the main idea of reading correctly	Cognitive
7	Able to make summaries and conclusions in accordance with the right concepts	Cognitive

4. Results

The results of the study were obtained by learning outcomes tests about writing skills and filling out questionnaires on the background of students' cognitive style of learning, the results are known from the Table 4.

Table 4. Description of writing skills with cognitive style (source: created by authors)

Learner's cognitive style	Without the help of...		Assisted by concept mapping...	
	...means	...standard deviation	...means	...standard deviation
Field-independent	67.86	6.04	73.75	5.37
Field-dependent	65.00	3.54	67.50	5.24
Writing style	67	10.45104	72.5	9.37102

Students' cognitive style has a significant effect on the practice of choosing learning methods both in the classroom and in the field through direct practice. Students with field-independent cognitive style are more confident in participating in learning so that they get better learning scores in all classes, both without the help of concept mapping and with the help of concept mapping, namely 67.86 and 73.75. Cognitive field-dependence was 65 and 67.5. Students who have a field-dependent cognitive style need more help from the teacher to understand the material being taught so that more attention is needed from the teacher.

The writing skills of students with PBL assisted by concept mapping have an average score of 72.5 better than students with PBL without the help of concept mapping, they have an average score of 67, the writing skills of students with field-independent cognitive style

have the ability to collect information, formulate problems, convey ideas and better, conclude more from better self-confidence. Furthermore, a test was conducted to determine the effect of PBL with the help of concept mapping on writing skills, the information can be obtained in the Table 5.

Table 5. Pairwise comparison (source: created by authors)

		Mean difference			95% confidence interval for difference	
Learner's cognitive style	Learner's cognitive style	(I-J)	Standard error	Significant[a]	Lower bound	Upper bound
Field-independent	Field-dependent	4.554*	1.634	.007	1.281	7.826
Field-dependent	Field-independent	–4.554*	1.634	.007	–7.826	–1.281

The results of the writing skill test with paired comparison testing obtained test significance value data between students who had field-dependent and field-independent cognitive styles obtained a value of 0.007 this data confirmed the difference between the two. The differences found in writing skills indicate a significantly different level of writing creativity (Table 6).

Table 6. Multivariate test results (source: created by authors)

Source	Type III sum				
	of squares	Difference	Mean square	Figure	Significant
Corrected model	692.679[a]	3	230.893	7.939	.000
Intercept	204691.361	1	204691.361	7038.510	.000
Group	191.902	1	191.902	6.599	.013
Cognitive style	225.956	1	225.956	7.770	.007
Group* Cognitive style	31.361	1	31.361	1.078	.304
Error	1628.571	56	29.082		
Total	294225.000	60			
Total corrected	2321.250	59			

The next stage is to examine the interaction between cognitive styles with the help of mapping the concept of creativity in writing from Table 6. The information obtained can be explained that the calculated F value is 7038.510 with a significance level of 0.013. The group that took the course with the help of concept mapping clearly differed in their writing skills without the help of concept mapping. The group of students with a cognitive style background scored 0.007. These data explain the differences in writing skills among students who have a field-independent cognitive style and students who have a field-dependent cognitive style. The interaction of cognitive style and concept mapping on the skills obtained is 0.304. These data explain that there is no real interaction between cognitive style and the use of concept mapping on writing skills. The interaction graph data generated during research testing are see in Figure 2.

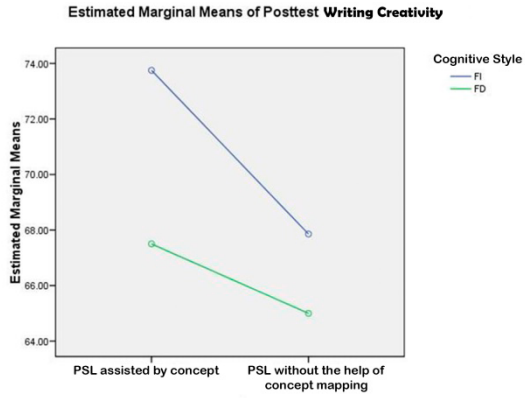

Figure 2. Interaction model (source: created by authors)

5. Discussion

Learning to solve problems with the help of concept mapping can increase creativity in writing. This shows that with writing skills, learning has better writing skills with an average score of 72.50. This writing skill is for students to explore information, formulate problems and convey ideas. Learning to solve problems without the help of concept mapping obtained an average score of 6.599 which was lower than those who received the help of concept mapping. Concept mapping involves creative thinking by involving students' imaginations so that it can stimulate students to make thinking concepts with direction and through creative activities and manifested in the writings produced by students. These results are in accordance with the opinion of Newland et al. (2019) who stated that creativity will grow quickly if stimulated by concept mapping which will give students concepts in thinking about something. Concept mapping is a learning media that can increase student learning creativity because students can see, imitate, practice, and can understand themselves from the material described. This practice also makes it easier for students to explain the problem they are looking for and find solutions faster through PBL.

Students with a field-dependent cognitive style who receive concept mapping assistance are able to convey ideas, formulate problems, and convey solutions better than students who do not receive mapping assistance. Those who have better writing skills get the help of concept maps to guide their flow of thinking so that activities find ideas and solutions more quickly through concept maps. A concept map is like a flow of thinking so that using concept map media is a creative process in conceptual thinking. Creativity is a series of lines of thought to discover new things about something that involves many creative dimensions. To foster creative behaviour, you must understand the flow of creative thinking which starts from identifying problems, formulating problems, conveying ideas and implementing solutions (Nurdiana & Suryanto, 2021; Suryanto et al., 2021a, 2021b).

The difference in writing creativity between students who have field-dependent and field-independent cognitive styles is clearly visible. Students with a field-dependent cognitive style have a character who likes to depend on the environment and is easily influenced by

their environment. Several findings show that students who have a field-dependent cognitive style are more dominant in collaborative activities and their creativity is influenced by group members. The better the quality of the work of group members, the better their writing creativity will be in collaborative practice. However, the bad impact of creative writing activities is that expository creative writing skills become less than optimal if group members are passive or wait for other members to carry out activities to dig up information, formulate problems, convey ideas and look for solutions. In this session, intervention is needed to moderate collaborative practices in group work practices. The information obtained shows how much cognitive style has a very dominant influence in responding to the stimuli they receive in collaborative activities. Cognitive style is a student's way of understanding something and their response to themselves or the environment (Flavell, 1979). Cognitive style influences the application of learning methods, therefore it is necessary to consider cognitive style in practice in the flow of learning objectives to be achieved (Arends, 2012; Suryanto et al., 2021b). Field-dependent students collaborate more easily in collaborative PBL due to their environment-dependent characteristics (Giancola et al., 2022; Witkin et al., 1977). In expository writing activities, students with a field-independent cognitive style improve their ability to dig up information, formulate problems, convey ideas and find solutions through personal creative processes. The collaboration process in group work practice is more interactive in discussions. The good ideas conveyed by students with a field-independent cognitive style influence the creative work of other group members in solving existing problems. However, several findings show that the ability to analyze problems independently and not be easily influenced by the environment also needs serious attention. Once again, moderation in collaboration is a serious concern so that the creative process can be carried out optimally.

In-depth interpretation of the research results found that there was no interaction between PBL with concept mapping and cognitive style in creative writing. This fact is more influenced by their learning style in the creative process, the collaboration process determines exposition writing activities through the creative process. Students with a field-dependent cognitive style have better collaboration abilities. Ability, empathy, and helping behaviour enable groups to work well together but they are greatly influenced by the environment. Due to the dominance of environmental influences, strict moderation is required when they collaborate through group work, while students with a field-independent cognitive style have better writing skills, they can complete their own solutions, express ideas and find solutions more quickly so that their thinking abilities are better. Good. Creativity in writing is better and able to complete assigned work. When group work practices are carried out by considering learning styles, collaboration is actually better and group discussions become more interactive. Providing ample opportunities for students in the creative process through collaborative group work practice activities is very necessary so that they can gain direct experience and improve their skills in solving existing problems in the future. The more it is clear and believed that education is a development in, by, and for the real experience given to students, the more important it is that we have a clear conception of what that experience is (Dewey, 1944). The results of the creative task differences between the third group of students in terms of the ability to pose problems and the complexity of the problems posed; while the first task (informal context), the difference between the second and fourth tasks was found between

groups, in the third task (formal context), there was no significant difference (Nicolaou & Xistouri, 2011). Cognitive style influences collaborative learning and this is the main point for educators to consider using learning methods in the classroom.

6. Conclusions

The diversity of unique learning styles between individuals needs to be taken into consideration in the practice of implementing collaborative learning. A variety of learning styles can support collaborative learning processes or even be less effective in collaborative learning practices in the field. Early detection of student learning styles is a necessity in implementing learning strategies and moderating learning activities. Students with an independent cognitive style are more dominant in formulating problems and conveying ideas. Meanwhile, students with a field-dependent cognitive style are able to carry out group work processes well. Variations in cognitive styles in collaborative learning practices are recommended because the collaborative learning process of both cognitive styles can support each other in creative performance. Expository writing creativity can continue to be enhanced with concept map media to make it easier for them to write in an interesting, structured manner, by conveying written ideas and by providing direct experience involving writing skills in every learning practice that is truly useful and necessary.

The application of problem PBL assisted by concept maps can increase writing creativity in the practice of learning to write scientific papers in the form of expository texts using concept maps through activities; dig up information about problems, write scientific papers in the form of expository texts with certain themes, formulate problems, convey ideas and look for solutions in concept maps. With the help of concept maps, writing scientific papers in the form of expository text can be made easier in the structure of writing expository text. Creativity in digging up information according to the topic they choose helps them determine important points to make creatively.

References

Aluri, V. L. N., & Fraser, B. J. (2019). Students' perceptions of mathematics classroom learning environments: Measurement and associations with achievement. *Learning Environments Research*, *22*, 409–426. https://doi.org/10.1007/s10984-019-09282-1

Amorim Oliveira, A. M. C., Santos, dos S. C., & Cardoso Garcia, V. (2013). PBL in teaching computing: An overview of the last 15 years. In *Proceedings of 2013 IEEE Frontiers in Education Conference (FIE)*. IEEE. https://doi.org/10.1109/FIE.2013.6684830

Anderson, L. W., & Krathwohl, D. R. (Eds.). (2001). *A taxonomy for learning, teaching, and assessing: A revision of bloom's taxonomy of educational objectives*. Longman.

Arends, R. I. (2012). *Learning to teach*. McGraw-Hill.

Ausubel, D. P., & Fitzgerald, D. (1961). The Role of discriminability in meaningful learning and retention. *Journal of Educational Psychology*, *52*(5), 266–274. https://doi.org/10.1037/h0045701

Bechara, A., Damasio, H., & Damasio, A. R. (2000). Emotion, decision making and the orbitofrontal cortex. *Cerebral Cortex*, *10*(3), 295–307. https://doi.org/10.1093/cercor/10.3.295

Bråten, I., Latini, N., & Haverkamp, Y. E. (2022). Predictors and outcomes of behavioral engagement in the context of text comprehension: When quantity means quality. *Reading and Writing*, *35*, 687–711. https://doi.org/10.1007/s11145-021-10205-x

Demetriou, A., Merrell, Ch., & Tymms, P. (2017). Mapping and predicting literacy and reasoning skills from early to later primary school. *Learning and Individual Differences*, *54*, 217–225. https://doi.org/10.1016/j.lindif.2017.01.023

Dewey, J. (1944). *Democracy and education: An introduction to the philosophy of education*. The Free Press.

Dewey, J. (1999). *Ervaring en opvoeding*. Bohn Stafleu van Loghum Houten. https://doi.org/10.1007/978-90-313-7131-0

Dewey, J. (1997). *Experience and education*. Free Press.

Eliot, J. A. R., & Hirumi, A. (2019). Emotion theory in education research practice: An interdisciplinary critical literature review. *Educational Technology Research and Development*, *67*, 1065–1084. https://doi.org/10.1007/s11423-018-09642-3

Finn, J. D. (2019). Academic and non-cognitive effects of small classes. *International Journal of Educational Research*, *96*, 125–135. https://doi.org/10.1016/j.ijer.2019.05.006

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, *34*(10), 906–911. https://doi.org/10.1037/0003-066X.34.10.906

Forthmann, B., Wilken, A., Doebler, Ph., & Holling, H. (2019). Strategy induction enhances creativity in figural divergent thinking. *Journal of Creative Behavior*, *53*(1), 18–29. https://doi.org/10.1002/jocb.159

Frenchs, P. (2012). *Problem solving and critical thinking* [unpublished source].

Gandolfi, E., Traverso, L., Zanobini, M., Usai, M. C., & Viterbori, P. (2021). The longitudinal relationship between early inhibitory control skills and emergent literacy in preschool children. *Reading and Writing*, *34*, 1985–2009. https://doi.org/10.1007/s11145-021-10131-y

Giancola, M., Palmiero, M., & D'Amico, S. (2022). Exploring the interplay between fluid intelligence and creativity: The mediating role of the field-dependent-independent cognitive style. *Thinking Skills and Creativity*, *45*. https://doi.org/10.1016/j.tsc.2022.101047

Giza, P. (2021). Creativity in computer science. *Creativity Studies*, *14*(2), 444–460. https://doi.org/10.3846/cs.2021.14699

Glaveanu, V., Lubart, T., Bonnardel, N., Botella, M., Biaisi, de P.-M., Desainte-Catherine, M., Georgsdottir, A., Guillou, K., Kurtag, G., Mouchiroud, Ch., Storme, M., Wojtczuk, A., & Zenasni, F. (2013). Creativity as action: Findings from five creative domains. *Frontiers in Psychology*, *4*. https://doi.org/10.3389/fpsyg.2013.00176

Glăveanu, V. P. (2018). Educating which creativity? *Thinking Skills and Creativity*, *27*, 25–32. https://doi.org/10.1016/j.tsc.2017.11.006

Gwiaździński, E., Kaczorowska-Spychalska, D., & Moreira Pinto, L. (2020). Is it a smart city a creative place? *Creativity Studies*, *13*(2), 460–476. https://doi.org/10.3846/cs.2020.12190

Hembrough, T. (2020). Integrating reading-to-write strategies and pairing composition and reading courses for first-year, at-risk college students. *International Journal of Instruction*, *13*(4), 177–196. https://doi.org/10.29333/iji.2020.13412a

Jász, B. (2018). Mental map of the city: Elements of visual argumentation and creativity in modern city planning. *Creativity Studies*, *11*(2), 284–293. https://doi.org/10.3846/cs.2018.6901

Kahn, J. (2020). Learning at the intersection of self and society: The family geobiography as a context for data science education. *Journal of the Learning Sciences*, *29*(1), 57–80. https://doi.org/10.1080/10508406.2019.1693377

Kulophas, Dh., Ruengtrakul, A., & Wongwanich, S. (2015). The relationships among authentic leadership, teachers' work engagement, academic optimism and school size as moderator: A conceptual model. *Procedia – Social and Behavioral Sciences*, *191*, 2554–2558. https://doi.org/10.1016/j.sbspro.2015.04.298

Laar, van E., Deursen, van A. J. A. M., Dijk, van J. A. G. M., & Haan, de J. (2019). Determinants of 21st-Century digital skills: A large-scale survey among working professionals. *Computers in Human Behavior*, *100*, 93–104. https://doi.org/10.1016/j.chb.2019.06.017

Lavie, I., & Sfard, A. (2019). How children individualize numerical routines: Elements of a discursive theory in making. *Journal of the Learning Sciences*, *28*(4–5), 419–461. https://doi.org/10.1080/10508406.2019.1646650

Leikin, M., Tovli, E., & Woldo, A. (2020). The interplay of bilingualism, executive functions and creativity in problem solving among male university students. *Creativity Studies*, *13*(2), 308–324. https://doi.org/10.3846/cs.2020.10397

Morales-Martinez, G. E., Ángeles Castellanos, A. M., Ibarra Ramírez, V. H., Iveth, M., & Mancera Rangel, M. I. (2020). Cognitive e-tools for diagnosing the state of medical knowledge in students enrolled for a second time in an anatomy course. *International Journal of Learning, Teaching and Educational Research*, *19*(9), 341–362. https://doi.org/10.26803/ijlter.19.9.18

Morales-Martinez, G. E., Lopez-Ramirez, E. O., & Lopez-Gonzalez, A. E. (2015). New approaches to e-cognitive assessment of e-learning. *International Journal for E-Learning Security*, *5*(2), 449–453. https://doi.org/10.20533/ijels.2046.4568.2015.0057

Newland, L. A., Mourlam, D., Strouse, G., DeCino, D., & Hanson, C. (2019). A phenomenological exploration of children's school life and well-being. *Learning Environments Research*, *22*, 311–323. https://doi.org/10.1007/s10984-019-09285-y

Nicolaou, A. A., & Xistouri, X. (2011). Field dependence/independence cognitive style and problem posing: An investigation with sixth grade students. *Educational Psychology: An International Journal of Experimental Educational Psychology*, *31*(5), 611–627. https://doi.org/10.1080/01443410.2011.586126

Nurdiana, R., & Suryanto, H. (2021). Increase creativity and activity in the creative study of problem solving-based human resource management. *Journal of Diversity in Learning*, *1*(4), 151–157.

Oliveira Sousa, de S. R., Vieira da Silva, W., Pereira da Veiga, C., & Ruviaro Zanini, R. (2020). Theoretical background of innovation in services in small and medium-sized enterprises: Literature mapping. *Journal of Innovation and Entrepreneurship*, *9*. https://doi.org/10.1186/s13731-020-00135-3

Paek, K.-M. (2019). The transformative potential of creative art practices in the context of interdisciplinary research. *Creativity Studies*, *12*(1), 183–197. https://doi.org/10.3846/cs.2019.9701

Potměšilová, P., & Potměšil, M. (2019). Cultural differences in creative reactions to an ambiguous stimulus. *Creativity Studies*, *12*(1), 119–130. https://doi.org/10.3846/cs.2019.718

Reindl, M., Tulis, M., & Dresel, M. (2020). Profiles of emotional and motivational self-regulation following errors: Associations with learning. *Learning and Individual Differences*, *77*. https://doi.org/10.1016/j.lindif.2019.101806

Roeser, J., Maeyer, de S., Leijten, M., & Waes, van L. (2024). Modelling typing disfluencies as finite mixture process. *Reading and Writing*, *37*, 359–384. https://doi.org/10.1007/s11145-021-10203-z

Schenkels, A., & Jacobs, G. (2018). "Designing the plane while flying it": Concept co-construction in a collaborative action research project. *Educational Action Research: Connecting Research and Practice for Professionals and Communities*, *26*(5), 697–715. https://doi.org/10.1080/09650792.2018.1429286

Sieck, W., & Yates, J. F. (1997). Exposition effects on decision making: Choice and confidence in choice. *Organizational Behavior and Human Decision Processes*, *70*(3), 207–219. https://doi.org/10.1006/obhd.1997.2706

Silberman, M. (1996). *Active learning: 101 strategies to teach any subject*. Prentice Hall.

Stagg Peterson, Sh., McIntyre, L. J., & Glaés-Coutts, L. (2018). Collaborative action research in northern Canadian rural and indigenous schools: Learning about young children's oral language in play contexts. *Educational Action Research: Connecting Research and Practice for Professionals and Communities*, *26*(5), 787–802. https://doi.org/10.1080/09650792.2017.1402686

Suryanto, H., Degeng, I. N. S., Djatmika, E. T., & Kuswandi, D. (2021a). The effect of creative problem solving with the intervention social skills on the performance of creative tasks. *Creativity Studies*, *14*(2), 323–335. https://doi.org/10.3846/cs.2021.12364

Suryanto, H., Warring, S., Sri Kartikowati, R. R., Rorimpandey, W. H. F., & Gunawan, W. (2021b). Study creativity with diverse social skills to support the learning process in future education. *Journal of Diversity in Learning*, *1*(2), 85–89.

Thompson, J. J., Hagenah, S., McDonald, S., & Barchenger, Ch. (2019). Toward a practice-based theory for how professional learning communities engage in the improvement of tools and practices for scientific modeling. *Science Education*, *103*(6), 1423–1455. https://doi.org/10.1002/sce.21547

Wart, van S., Lanouette, K., & Parikh, T. S. (2020). Scripts and counterscripts in community-based data science: Participatory digital mapping and the pursuit of a third space. *Journal of the Learning Sciences*, *29*(1), 127–153. https://doi.org/10.1080/10508406.2019.1693378

Williams, R., Runco, M. A., & Berlow, E. (2016). Mapping the themes, impact, and cohesion of creativity research over the last 25 years. *Creativity Research Journal*, *28*(4), 385–394. https://doi.org/10.1080/10400419.2016.1230358

Witkin, H. A., Moore, C. A., Goodenough, D. R., & Cox, P. W. (1977). Field-dependent and field-independent cognitive styles and their educational implications. *Review in Educational Research*, *47*(1), 1–64. https://doi.org/10.3102/00346543047001001

Yeonjoo Lee, J., Donkers, J., Jarodzka, H., & van Merriënboer, J. J. G. (2019). How prior knowledge affects problem-solving performance in a medical simulation game: Using game-logs and eye-tracking. *Computers in Human Behavior*, *99*, 268–277. https://doi.org/10.1016/j.chb.2019.05.035