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Effects of Problem-Solving Activities on Korean Young Learners' Critical Thinking and English Production

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This study investigated the effects of complex problem-solving activities involving children's literature on students' critical thinking dispositions and English production. Thirty-one sixth-grade students were given lessons over a seven-week period. Various types of data were analyzed qualitatively, and the results of a critical thinking disposition test were analyzed quantitatively. Results were as follows: First, the critical thinking dispositions test revealed positive changes in open-mindedness, independence, objectivity, and inquisitiveness. The highest score was found for open-mindedness. The largest increase in score was for independence and objectivity. Second, changes in critical thinking dispositions enriched children's English production. Open-mindedness helped with spoken language production as it encouraged students to share their opinions freely. Independence was mainly expressed in writing form in which students could question and evaluate the text. Greater objectivity was applied to spoken and written language production as the subjects were able to recognize the importance of evidence. Inquisitiveness affected children's writing as it drove them to write down the results of their own research.

Key words: children's literature, critical thinking dispositions, complex problem-solving, primary English, productive skills, twin texts

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1. INTRODUCTION

According to South Korea's 2015 revised English curriculum, the overall goal of Korean primary English education is to develop learners' English communication skills (Ministry of Education, 2015). Communication is a two-way activity, and it is an act of exchanging information or knowledge between two or more people using verbal and nonverbal means (Kim, 1994). In other words, it can be said that the ultimate goal of language teaching is to enable learners to express their thoughts, opinions, and experiences in spoken or written form. In an EFL environment with limited target language exposure, a teaching method that provides appropriate input and sufficiently supports learners to use and produce language as a means of communication is needed.

In addition, 21st century education should provide more complex and dynamic learning opportunities than traditional lectures do. Students in this era must have the abilities to live and work in ever-changing environments. Therefore, education should prepare them to develop the 21st century skills necessary to thrive in such environments, one of which is critical thinking. Students who will live in the society of the future must become critical thinkers capable of analyzing and evaluating various factors. They also need to be able to question received ideas and knowledge when forming judgements. In particular, students learning a new language need to think critically because they are being exposed to a new culture and a variety of ideas at the same time (Alagözlü & Süzer, 2010). Because critical thinking does not develop on its own, it needs to be taught and practiced deliberately from an early age (Fisher, 1999).

Although the definition of critical thinking varies among scholars, there is a general consensus that critical thinking abilities consist of thinking dispositions as well as thinking skills, and that the two elements work together. People with developed critical thinking dispositions can apply critical thinking more appropriately in their personal and social life than those who have only mastered critical thinking skills (Facione, 1990).

Attempts have been made among educators to teach critical thinking through several methods. Educators have sought to implement supplementary methods of teaching critical thinking to students beyond the traditional didactic approaches (Howard, Tang, & Austin, 2015). This paper attempts to answer the question, "Is it possible to enhance critical thinking through problem-solving activities?" In problem-solving activities, students are exposed to real-world problems. They use critical thinking to participate in the decision-making process. Critical thinking is not the process used to find an answer, but the ability to use reason and judgement to discover why an answer fits logically and creatively within a certain context. Therefore, problem-solving is the practice and discipline whereby critical thinking is used strategically to recognize problems and generate solutions. In addition, activities that involve solving problems and expressing the results in the target language verbally or in writing can

help learners improve their language production skills, and this method is suitable for developing the communication skills required in real life.

To teach critical thinking, literature can be used. In foreign language classes such as English, literature is an important tool to promote students' critical thinking abilities. Literature enables students to reflect on the world around them and changes their attitudes toward it (Tabačková, 2015). Moreover, it is suitable for problem-solving activities because it deals with various topics such as home and school life, history, society, and politics. By considering puzzling, thought-provoking questions, students have the opportunity to think about various issues and express their thoughts (Russell, 2009).

Recently, several studies in the field of English education have been conducted to investigate problem-solving activities. However, in most cases, they focused on the effects on academic achievement or the affective domain among middle and high school students. Studies in elementary education have been limited, with even fewer studies on the relevance of critical thinking (Kim, 2019; Lee, 2009; Park, 2011). In addition, while most research on critical thinking has focused on critical thinking skills (Dwyer, Hogan, Harney, & Kavanagh, 2017), research on critical thinking dispositions and, in particular, strategies to promote critical thinking dispositions is lacking (Yang & Chou, 2008). Furthermore, the effects of critical thinking ability on the four language skills are often presented only as statistical figures, so an in-depth analysis of children's language production patterns during problem-solving activities is needed. Therefore, this study aims to investigate the possibility of using complex, literature-based problem-solving activities to improve elementary school students' critical thinking ability and English production. In this study, critical thinking ability is divided into critical thinking skills and dispositions, and the effects are analyzed by focusing on critical thinking dispositions. The research questions are as follows:

1) How do complex problem-solving activities using children's literature affect learners' critical thinking dispositions?
2) How do learners' English production patterns reflect their critical thinking dispositions?

2. REVIEW OF THE LITERATURE

2.1. Complex Problem-Solving and English Learning

Problem-solving, a higher order thinking skill that requires complex information processing skills, is a dynamic process that is applied to various situations encountered frequently in life (Greeno, 1978). Complex problem-solving is a concept introduced in

Germany in the 1970s; it refers to the ability to solve ill-defined real-life problems (Dörner & Funke, 2017). Real life problems such as job shortages and environmental issues are caused by multiple factors and involve many variables. They are tied to various fields, and their solutions are unclear. Therefore, in complex problem-solving activities, students cross the boundaries of the subject they are dealing with and approach problem-solving in an integrated way, which helps them to improve many kinds of abilities.

The world is changing rapidly and students will face new social, economic, and environmental challenges in the future. To accommodate the demands of the future, it is necessary to teach complex problem-solving in English education (Kim, 2012). In South Korea's 2015 English curriculum, three core competencies were presented that students need in order to solve problems as global citizens. These are "knowledge and information processing competency," the ability to appropriately utilize information expressed in English; "communication competency," the ability to exchange ideas in English; and "community competency," the ability to participate in problem-solving as a member of the community (Ministry of Education, 2015). Therefore, it is necessary for students to find the optimal information needed to solve problems and to produce and share information in English.

In addition, language learning and cognition are closely related, so educating students in thinking skills, for example, through problem-solving activities, is emphasized in foreign language classes (Chapple & Curtis, 2000). Higher order thinking skills help in the development of learning skills, which can lead to high-level language learning (Vacca, Vacca & Gove, 1995). In particular, in problem solving activities, the learner is at the center of the learning process and solves problems individually or as a team. In this process, students have the opportunity to practice various language skills and participate in meaningful language production while using the target language to create meaning and to interact with others. Complex problem-solving activities based on subject integration can also increase learners' interest and improve their academic language proficiency through having to use knowledge appropriate to their cognitive level. This compensates for some of the limitations of South Korea's current elementary English education system, which has been focusing on improving basic communicative skills in everyday life (Cummins, 1979).

In fact, several studies in the field of English education have revealed that problem-solving activities can effectively improve communication ability, academic achievement, attitude, etc. Choi (2005) found that problem-solving activities had a positive effect on middle school students' English writing ability and attitude. In primary English education, there was an improvement in learners' speaking as a result of developing and applying a problem-solving program in a fifth grade English class (Park, 2011). Problem-solving activities using creative thinking techniques also improved learners' English listening and speaking fluency and language creativity, and had a positive effect on their learning attitude (Kim, 2019).

2.2. Problem-Solving and Critical Thinking

Critical thinking, a higher-order thinking skill, has various definitions. Ennis (1996) claims that critical thinking is logical-reflective thinking, emphasizing logic, reflection, and the process of making decisions. Linn (2000) states that critical thinking involves various skills, such as identifying the source of information, analyzing its credibility, reflecting on the information, and drawing conclusions. Shin, Ma, Park, Ji, and Kim (2015) define critical thinking as "certain assessment with certain purposes generated through steps of interpretation, analysis, evaluation, and drawing conclusions." The definitions of critical thinking are varied but they commonly emphasize the ability to "understand the thoughts, make sense of the ideas, and make logical decisions." (Nosich, 2012).

Problem-solving and critical thinking are closely related. The steps of problem-solving are as follows: 1) defining the problem correctly and understanding its structure in order to set goals for arriving at a solution, 2) identifying as many different solutions as possible, 3) deciding on the most appropriate solution, 4) implementing the solution and evaluating the results obtained in a logical framework (Çam & Tümkaya, 2007).

Gathering and encoding data related to an event, explaining a problem by referring to similarities and differences, formulating a solution plan, using knowledge and principles, and evaluating possible solutions require cognitive processes and involve such concepts as assumption, bias, inference, and argument. In other words, critical thinking is required throughout the problem-solving process (Kapa, 2001).

Therefore, critical thinking can be enhanced through problem-solving. Through problem-solving activities, students will learn how to sort out various opinions, so that they can distinguish which are relevant and irrelevant, which are reasonable and unreasonable. They make conclusions by considering data and facts. Problem-solving is thinking critically and producing a solution by processing information (Seferoğlu & Akbıyık, 2006) which in the end promotes critical thinking.

In fact, several studies have shown that problem-solving based learning can improve critical thinking. Snyder and Snyder (2008) found that students became independent learners and thought critically when they were able to analyze, evaluate, and synthesize information from various sources and explain according to their level of understanding while participating in problem-solving activities.

2.3. Critical Thinking Disposition

Critical thinking is difficult to define conclusively because people have different backgrounds, thinking tendencies, and cultures. However, many scholars agree that critical thinking includes affective characteristics such as attitude and disposition, in addition to

cognitive thinking skills (Ennis, 1996; Facione, 1990). Critical thinking skills refer to the ability to think critically by using certain mental methods, and critical thinking disposition is an individual's desire and motivation to think critically (Zhang, 2003). Skills are only used when this disposition increases. In other words, the tendency to think critically is necessary for activating thinking skills. These two concepts are inseparable.

Ennis (1985) refers to critical thinking disposition as searching for the cause, using reliable data, looking at the problem holistically, focusing on the main problem, putting together complex parts, and being open-minded. According to Tishman, Jay, and Perkins (1993), to have a critical thinking disposition is to be open-minded, find and conceptualize problems, plan and develop strategies, understand, seek the truth, work and reflect on mental processes. Facione, Facione, and Giancarlo (1996) describe critical thinking disposition as being analytical, systematic, and open-minded, having cognitive maturity, curiosity and self-confidence, and searching for truth. Similarly, in Korea, Jo, Kim, Seol, and Jeong (2009) explain critical thinking disposition as truth-seeking, openness, inquiry, objectivity, systemicity, and self-reliability. These tendencies do not arise by chance but are nurtured over a long period of time through continuous learning (Lee, 2002; Paul, Binker, & Weil, 1995).

With researchers calling for more investigations into critical thinking dispositions, the literature on critical thinking dispositions has been growing. The literature includes some evidence indicating that critical thinking disposition is related to good professional practice, and it has also been positively and moderately associated with problem-solving (Kirmizi, Saygi, & Yurdakal, 2015). Joalise and Willem (2021) investigated eight strategies used in classrooms, including assessments, questioning, examples, and the classroom environment that foster critical thinking dispositions. There have also been some studies investigating the impact of certain teaching models or tools on learners' critical thinking dispositions. Sim (2021) suggested that when learners viewed academic writing as a socially situated practice, and not as a task to be completed to fulfil academic requirements, critical thinking dispositions were honed driving them to writing with more criticality. Robillos (2022) suggested that the use of the LoiLooNote digital graphic organizer, a software mapping tool in the EFL classroom, increased university students' oral presentation performance and their critical thinking dispositions such as inquisitiveness, open-mindedness, analyticity, and truth-seeking. A study by Ilkorucu, Tapan, and Boyaci (2022) showed that CT-4MAT (Four Mode Application Techniques) instruction helped middle school students gain critical thinking dispositions and evaluate biodiversity from a more critical point of view.

3. METHODOLOGY

3.1. Research Participants and Period

The participants in this study were 31 sixth grade students (16 boys and 15 girls) from an elementary school in Seoul, South Korea. The researcher provided a research plan and got signed permission forms from the parents of the students involved in this research and from the students themselves. Among the participants, 21 students (68%) had started learning English before third grade, when they began learning English through the regular school curriculum. Many had previously studied listening, speaking, reading, and writing. Among the students, 24 had studied English vocabulary words, 24 had used reading books, 20 had studied writing, 20 had studied grammar, 18 had taken a conversation class, and 9 had focused on reading comprehension. Moreover, it was found that most of the students had read over 100 books in English. Thirteen of the students (42%) had lived and studied in English speaking countries for 6 to 12 months.

Based on a diagnostic test and reading comprehension test, the students were divided into three groups according to overall English proficiency: high, intermediate, and low. The national assessment of educational achievement was used for the diagnostic test, and the reading comprehension test was developed using the questions from the nationally certified English test, TOSEL (Test of Skills in the English Language) basic and junior level, such that most of the reading passages were used as they were, while the questions and options were modified. Based on the results of these tests, nine students (29%) were classified as high level, having gotten 100 on the diagnostic test and 88 or above on the reading comprehension test. Fifteen students (48%) were classified as intermediate level, having gotten 88 or above on the diagnostic test and 68 or above on the reading comprehension test. Lastly, seven students (23%) were classified as low level, having gotten 60-92 on the diagnostic test and 16-64 on the reading comprehension test. Generally speaking, the participants had a lot of experience in learning English and were fairly competent in English.

Experimental classes were conducted over a total of 14 periods throughout a seven-week period, during the second semester of 2020. Classes were conducted both online and offline.

3.2. Text Selection

In this study, children's literature was used as language and content input for complex problem-solving activities. While selecting texts, the researcher considered the conditions for selecting literary texts for English learners (Hadaway, Vardell, & Young, 2002) which are content, language, visual, and cultural accessibility. In particular, in terms of content accessibility, content deemed to be of interest to elementary school students and likely to

help them develop inquiry and problem-solving skills was selected. In terms of language accessibility, texts were selected in consideration of the Lexile measures developed by Metametrics, an American educational evaluation institution, to suit the language level of the children. In addition, story elements such as plots, characters, and themes were considered (Kim, 2015).

To promote children's critical thinking through literature, the researcher also considered the four dimensions of critical literacy coined by Lewison, Flint, and Van Sluys (2002): (1) disrupting the commonplace, (2) interrogating multiple viewpoints, (3) focusing on sociopolitical issues, and (4) taking action and promoting social justice. In this study, the researcher mainly focused on the third and fourth dimensions.

For complex problem-solving activities, the researcher chose themes that reflected real-life problems and allowed students to use knowledge from various subjects in an integrated way. The problems were relatable for the students and suitable for the cognitive level of elementary school students. Then, appropriate texts were selected for each theme. The texts needed to concern topics that students could apply to real-life. Texts were sought that featured various characters, plots, or conflicts or that raised sociopolitical issues such as climate change, race, poverty, or internet addiction. Such texts help learners improve their critical thinking skills through the process of recognizing and solving textually related problems in various ways.

When selecting texts for each problem-solving theme, the idea of twin texts was applied. Twin texts are two books, one fiction and one nonfiction (informational), on the same or a related topic[1] (Camp, 2000). Pairing fiction and nonfiction books on the same topic can boost students' understanding and enjoyment and expand their interaction with the topic. It is also a viable method for both teaching and learning critical reading and thinking skills (Vacca & Vacca, 1999). In this regard, two texts related to each theme were used: the first text was used for problem recognition and the second text was provided for problem-solving, allowing children to explore solutions by considering various problem-solving approaches along with the results that presented in the book. The texts used in this study are shown in Table 1.

1 For example, the fictional work, *Stellaluna* by Janell Cannon can be paired with the nonfiction work, *Bats* by Celia Bland.

TABLE 1

Themes and Texts

Theme	Text	Author	Lexile
Eating habits	*Why Should I Eat Well?*	Claire Llewellyn, Mike Gordon (2005)	500L
	I Will Never Not Ever Eat a Tomato	Lauren Child (2003)	470L
Relationship	*When Sophie Gets Angry-Really, Really Angry...*	Molly Bang (2004)	340L
	How to Lose All Your Friends	Nancy Carlson (1997)	480L

3.3. Instructional Model

The instructional model was designed to have three stages: engaging thinking, problem-solving, and sharing. Each theme unfolded over seven class periods, which were conducted within the school curriculum as a club activity. The so-called "smalog" approach was used, combining "smart" and "analog" including both online and offline classes. The instructional model, including the main activities for each stage, is shown in Table 2.

TABLE 2

Complex Problem-Solving Instructional Model

Stage	Steps	Main Activities	Class Type		Period
			Online (min)	Off-line (min)	
Engaging thinking	Motivation	Engaging students' thought about given topic	20	20	1
Problem-solving	Recognizing the problem	Skimming Book1	15	-	2
		Reading Book1 Recognizing the problem in the book	-	25	
	Figuring out the cause	Exploring the cause of the problem	30	-	3
		Sharing the results	-	10	
	Exploring the solutions	Reading Book2	15	-	4
		Learn how to solve problems though Book2	-	25	
	Problem-solving	Having a discussion about how to solve the problem Solving the problem	-	30	5~6
		Produce problem-solving results	50	-	
Sharing	Sharing results and giving feedback	Presenting the results Assessment and reflection	-	30	7
		Completing a class survey	10	-	

First, in the engaging stage, children recalled experiences related to the problem that needed to be solved and activated their background knowledge. They also learned vocabulary related to the theme.

Second, in the problem-solving stage, students were instructed to solve the problem systematically by going through the process of recognizing the problem, identifying the cause of the problem, finding out how to solve the problem, and solving the problem. To recognize the problem, students read the first book and identified the problem. In other words, based on their understanding of the text, they considered what the problem was and why it was a problem. To figure out the cause, students tried to identify the cause of the problem through online learning in various ways, relying on past experience, background knowledge, internet searches, and related books. Then, they shared the results with the class. To explore the solutions, students learned how to solve the problem through reading the second book. In this book, they saw an example of how to solve a problem, and based on this, they were able to explore various solutions on their own. The final part of problem-solving involved each group discussing how to solve the problem during offline classes. There were seven groups, each consisting of four or five students with different language levels as determined through the English diagnostic evaluation, reading comprehension test and class participation. Based on the group discussions, two or three children living close to each other gathered in small groups to finally choose a problem-solving approach and make a plan to share. The results were produced in the form of a video at home, using online class time, and uploaded onto the web so that the results of the problem-solving process could be shared.

Lastly, in the sharing stage, children evaluated each other's solutions in offline classes by watching some of the videos submitted. The activity concluded with a written class survey.

Since teaching English in English is recommended in South Korea, children were encouraged to use English, but some Korean was allowed to encourage students to participate actively.

3.4. Data Collection and Analysis

Various types of data, including worksheets, journals, a critical thinking disposition test, a questionnaire, interviews, and transcripts were collected. First, all the worksheets used in classes were collected. Children were also asked to write journal entries in a notebook after reading each book. They expressed their thoughts or opinions freely. A total of 124 journal entries written by the 31 children on 4 books were collected. For these worksheets and journals, children were encouraged to use English.

The critical thinking disposition test was developed in the form of a questionnaire, using a Likert 5-point scale in Korean. For item development, Adolescent Life Core Competency Development and Promotion Plan Ⅱ: Thinking Skill (Jo et al., 2009) and the K Critical

Thinking Disposition Test (KCTDT) developed by the Korea Curriculum and Evaluation Institute were examined in line with the constructs mentioned by several scholars who have defined critical thinking disposition (Ennis, 1985; Facione, Facione, & Giancarlo, 1996; Jo et al., 2009; Tishman, Jay, & Perkins, 1993). As a result, 14 items were developed to assess open-mindedness, independence, objectivity, and inquisitiveness, taking into account elementary school students' cognitive levels. The Cronbach's alpha for pre- and post-tests were .86 and .88 respectively.

For the questionnaire, students were instructed to write down their thoughts and feelings about the class, about memorable activities, and about what they had learned in Korean or English after completing all the activities for each topic.

When it was difficult to interpret the child's reaction through the worksheets or questionnaire, the researcher tried to clarify it through an interview with the child. In addition, after all the experimental classes were over, three children were selected from each level for a voluntary interview, with an individual interview being conducted for about 10 minutes in the classroom after school. The interview was semi-structured, concerning class satisfaction and impressions, difficult or challenging points, and areas for improvement. These interviews were done in Korean.

Finally, all activities in the class were recorded, including group and whole class discussions, presentations, and videos produced by children as a result of problem-solving, and the parts worthy of discussion were transcribed.

For data analysis, a qualitative analysis (Glesne, 2006) was used to comprehensively analyze all the collected data from various angles and establish a series of order, system, and meaning. First, the collected data was typed up as a document. Recorded data were also transcribed using transcription codes (Shagoury & Power, 2012) such as "…" (pause), "CAPS" (emphasis), and "( )" (explanation). The process of analysis involved organizing the data, conducting a preliminary read-through of the database, coding and organizing themes, representing the data, and interpreting the data. For validation strategies, persistent observation, triangulation, debriefing, and rich and thick description were used (Creswell & Miller, 2000). That is, as a homeroom teacher, the researcher tried to establish rapport with the students and conducted persistent participant observation. In triangulation, the researcher made use of multiple and varied sources and methods to provide corroborating evidence. For the debriefing, one professor in this field and one elementary school teacher enrolled in an English education doctoral program reviewed the entire research process including data coding, categorizing and interpretation of results. Lastly, the researcher provided abundant, interconnected details when describing each theme.

In addition, this study quantitatively analyzed the results of the critical thinking disposition test and used it in the discussion. Paired *t*-tests were performed on the pre- and post-scores of the critical thinking disposition test, and the results were analyzed to determine whether

there were significant improvements on the whole and in terms of sub-areas of critical thinking disposition.

4. FINDINGS AND DISCUSSION

4.1. Changes in Critical Thinking Dispositions

4.1.1. Overall change in critical thinking disposition

In order to investigate the changes in the critical thinking dispositions of participating children, a paired *t*-test was carried out to determine the critical thinking dispositions pre- and post-scores, as shown in Table 3.

Table 3

Paired *T*-Test for Critical Thinking Dispositions Pre- and Post-Scores (*n* = 31)

Area	Test	*M*	*M* per item	*SD*	*t*	*p*
Open-mindedness (25)	pre	20.35	4.07	2.30	-3.99***	.000
	post	21.87	4.37	1.92		
Independence (15)	pre	10.35	3.45	1.84	-4.73***	.000
	post	11.90	3.97	1.58		
Objectivity (15)	pre	10.71	3.57	1.88	-4.08***	.000
	post	12.26	4.09	1.55		
Inquisitiveness (15)	pre	10.55	3.52	2.43	-3.55***	.000
	post	11.61	3.87	1.86		
Total (70)	pre	52.0	3.71	6.07	-6.41***	.000
	post	57.6	4.11	4.91		

***$p < .001$

The total score of the pre- and post-tests show that the means differ. The mean value for the post-test (i.e., $M = 57.6$) is higher than that of the pre-test (i.e., $M = 52.0$). This difference was statistically significant, with $t = -6.405$ ($p < .001$). Therefore, English classes using complex problem-solving activities had a positive effect on the cultivation of children's critical thinking dispositions overall. Among these, the highest score in the post-test was found for open-mindedness, the largest increase in score was found for independence and objectivity, and the lowest score was found for inquisitiveness.

4.1.2. Changes by sub-area of critical thinking dispositions

In order to examine changes in each sub-area of critical thinking dispositions, in terms of open-mindedness, independence, objectivity, and inquisitiveness, the test results for each item in each area are presented in Tables 4-7. First, the results of the paired *t*-test for the pre- and post-scores for each item in open-mindedness are presented in Table 4. The sub-items of open-mindedness are listening to other people's opinions, understanding others, understanding other cultures, respecting other people's viewpoints, and understanding diverse viewpoints, which correspond to items 1 to 5.

Table 4

Paired *T*-Test for Pre- and Post-Scores in Open-Mindedness (*n* = 31)

No	Item	Test	*M*	*SD*	*t*	*p*
1.	listening to other people's opinions	pre	4.39	0.62	-3.013**	.003
		post	4.77	0.43		
2.	understanding others	pre	4.06	0.63	-2.785**	.005
		post	4.41	0.50		
3.	understanding other cultures	pre	3.58	0.88	-1.306	.101
		post	3.74	0.77		
4.	respecting other people's viewpoints	pre	4.1	0.74	-.2.990**	.003
		post	4.45	0.62		
5.	understanding diverse viewpoints	pre	4.23	0.67	-2.497**	.009
		post	4.48	0.63		

**$p < .01$

According to the analysis, there were increases in the scores for all the open-mindedness questions except for understanding other cultures. This shows that English classes in which complex problem-solving activities are employed had a positive effect on children's open-mindedness overall.

The item with the highest pre- and post-score was listening to the opinions of others. The children came to better understand the importance of listening to others in discussing and sharing solutions to problems. On the other hand, there was no significant improvement in understanding other cultures. This seems to be because the selected texts or activities did not deal with cultural issues. Some of the relevant responses[2] are presented below.

> It was good to know how other people think while discussing solutions.
> (Ha-min[3], Questionnaire, 9/7/2020)

2 These were translated into English.
3 Students' names are pseudonyms.

> In peer assessment, it would have been nice to see more videos my friends had made and have conversations with them. That way I can hear more solutions and different ideas. (Mi-so, Questionnaire, 10/12/2020)

> When I see my friends' ideas that are different from mine, I can judge the flaws in my own thinking and it was helpful to correct my thought. (Yun-chae, Interview, 10/14/2020)

In the responses above, the children recognized the importance of listening to others while discussing problem-solving solutions and sharing their results. It is worth noting that Yun-chae came to think in a more open-minded way by acknowledging that her thoughts are not always right.

Next, the results of the paired *t*-test for the pre- and post-scores for each item in independence are presented in Table 5. Independence is the tendency to think independently without being influenced by external factors such as authority, acquaintance, and the power of the public when making judgments. Questions 6 to 8 were evaluated as sub-items of questioning authority, questioning public opinion, and criticizing text against the author's authority.

Table 5

Paired *T*-Test for Pre- and Post-Scores in Independence (*n* = 31)

No	Item	Test	*M*	*SD*	*t*	*p*
6.	questioning authority	pre	3.74	0.86	-3.437***	.000
		post	4.29	0.74		
7.	questioning public opinion	pre	3.45	0.89	-2.886**	.004
		post	3.97	0.80		
8.	criticizing text	pre	3.16	0.93	-3.028**	.003
		post	3.65	0.71		

**$p < .01$, ***$p < .001$

According to the analysis, all three items in independence showed a statistically significant increase. This shows that English classes in which complex problem-solving activities are used had a positive effect on children's independence. Specifically, the highest pre- and post-score among the three items is that of questioning authority, which also showed the most improvement. That is to say, children had a subjective tendency to resist agreeing unconditionally with the author's opinion.

> Before I used to read without much thought. Now, I often think about why this author wrote this book, or why the main character here acted like this.
> (Mi-so, Interview, 10/14/2020)

> Not thinking everything is good but examining further or thinking why? Really? Seriously? is critical thinking. (Su-jin, Interview, 10/14/2020)

> It helped me to think more about things that were not directly in the book.
> (Dong-min, Questionnaire, 10/12/2020)

In the responses cited, children mentioned aspects of independence in using critical thinking to question an opinion or idea. In addition, when they read books, it was possible for them to challenge the author's way of thinking and review the content independently, rather than just accepting it. This tendency could be further cultivated by using a rational thinking process: consistently forming one's own opinions while evaluating the behavior of the characters presented in the text.

Next, the results of the paired *t*-test for the pre- and post-scores for each item in objectivity are presented in Table 6. Objectivity excludes emotional and subjective factors, draws conclusions based on empirical and valid evidence, and tends to establish a position when evidence and reasons are sufficient. The sub-items were verifying the evidence, considering reasonable accuracy, and being wary of hasty conclusions, which correspond to items 9 to 11.

Table 6

Paired *T*-Test for Pre- and Post-Scores in Objectivity (*n* = 31)

No	Item	Test	*M*	*SD*	*t*	*p*
9.	verifying the evidence	pre	3.90	0.70	-3.981***	.000
		post	4.39	0.62		
10.	considering reasonable accuracy	pre	3.74	0.82	-2.468*	.01
		post	4.23	0.76		
11.	being wary of hasty conclusions	pre	3.06	0.85	-3.503***	.000
		post	3.64	0.71		

*$p < .05$, ***$p < .001$

According to the analysis, all three items in objectivity showed a statistically significant increase. Therefore, it can be said that English classes featuring complex problem-solving activities had a positive effect on children's objectivity. In other words, children were able to develop objectivity to confirm reasons or evidence while expressing their thoughts.

Looking at each item, the highest post-test score was for verifying the evidence, which also received a high score in the pre-test, with an average of 3.9. This seems to be because the children had already become well aware of the importance of valid reasons or evidence through their Korean language classes. The score rose to 4.39 on the post-test, which means children are more aware of the importance of valid evidence when presenting their own ways of problem-solving to others. The item with the greatest improvement in score was being wary of hasty conclusions. The process of presenting one's own thoughts and listening to others' opinions led to an awareness of the importance of carefully establishing a position backed by valid and sufficient reasons. This can also be seen in the following survey and interview extracts.

> Because I found a solution based on the book, my eating habits, and my thoughts, it helped me to improve my ability to judge according to justifiable reasons or evidence. (Yeon-ju, Questionnaire, 10/12/2020)

> I realized that solving a problem was not a simple task but a challenging one which has to be done more thoroughly. You compare your idea with various others, check the pros and cons, and keep thinking about which one is better in order to think better. (Dong-jun, Interview, 10/14/2020)

In the responses cited, it was noted that children were able to identify valid reasons when seeking ways to solve problems. Also, they were wary of being emotional or impulsive during the problem-solving process, as this could make it hard to solve the problem properly.

Lastly, the results of the paired *t*-test for the pre- and post-scores for each item in inquisitiveness are presented in Table 7. The sub-items of inquisitiveness are raising questions and searching for answers, positive attitudes toward inquiry, and desire to learn, which correspond to items 12 to 14.

Table 7

Paired *T*-Test for Pre- and Post-Scores in Inquisitiveness ($n = 31$)

No	Item	Test	*M*	*SD*	*t*	*p*
12.	raising questions and searching for answers	pre	3.35	1.02	-3.981***	.000
		post	3.84	0.78		
13.	positive attitudes toward inquiry	pre	3.55	0.92	-2.785**	.005
		post	3.90	0.87		
14.	desire to learn	pre	3.65	0.88	-1.157	.128
		post	3.87	0.88		

**$p < .01$, ***$p < .001$

According to the analysis, both the pre- and post-scores for this area were less than 4 points, which was generally lower than the scores for other tendencies. However, there was a statistically significant increase at the level of $p < .05$ in two out of three questions in the post-test. This means that before the experimental class, students had a low tendency to explore the in-depth contents related to the text on their own, but this kind of English class, which featured complex problem-solving activities, had an overall positive effect on children's inquisitiveness. There was no significant improvement in "I want to learn a lot while trying to solve problems that do not seem to have an answer." This may be due to a general academic burden felt by the children or due to personal preference.

The item with the largest increase in score was raising questions and searching for answers, with an increase from 3.35 to 3.84. Children were able to naturally develop this tendency through the process of discovering problems in texts and solving them through an inquiry process.

> In the process of finding out how to solve problems, it seems that my thinking skills have improved a lot. (Dong-jun, Questionnaire, 9/7/2020)

> I could learn something good for my health. In English textbooks, I can only learn "must", past tense and things like this, but through this activity I can get some knowledge for real life. (Do-hyeon, Interview, 10/14/2020)

> It was memorable because I did some research on the internet about the problem by myself and wrote it down. (Do-hwan, Interview, 10/14/2020)

In the examples cited, the children showed a positive attitude toward the problem-solving process of conducting an inquiry. Do-hwan expressed his satisfaction with the research process that he took the lead in. Dong-jun mentioned improvements in his thinking ability, and Do-hyeon mentioned having gained useful knowledge or information during the inquiry process. The children's positive attitude toward inquiry strengthened their inquisitiveness and fostered a willingness to ask questions and search for answers when questions arose.

4.2. Language Production According to Changes in Critical Thinking Dispositions

The complex problem-solving activities involving children's literature had a positive effect on critical thinking dispositions, namely, open-mindedness, independence, objectivity and inquisitiveness. This change in critical thinking dispositions has had an effect on students' target language production. In this section, based on the changes in the critical thinking

dispositions discussed earlier, language production is examined in parallel with the changes in each disposition. The students' language production is discussed in terms of both spoken and written language production.

4.2.1. Language production according to change in open-mindedness

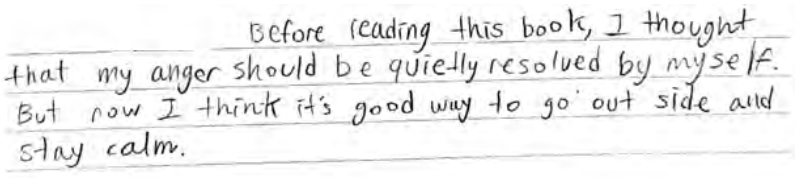
Through complex problem-solving classes featuring children's literature, the students cultivated a tendency to listen to other people's opinions and respect various viewpoints towards problem-solving. Furthermore, when the opinions of others were judged to be reasonable, students accepted them and showed a willingness to change their own thoughts. This open-mindedness affected students' English speaking and writing.

First, children's attitude toward sharing opinions with each other with an open mind promoted spoken language production. The following is part of a group discussion in which one of the groups discussed ways to solve eating problems after reading *I Will Never Not Ever Eat a Tomato.*

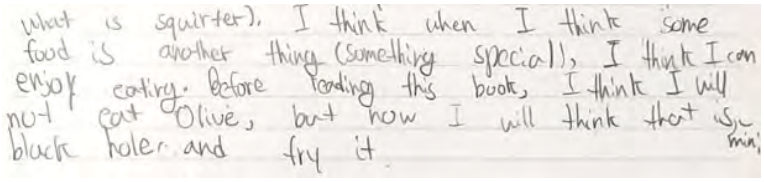
> So-yeon: I think giving prize is good. People like to get prize. So if we give prize, they will eat it. What do you think?
>
> Su-jin: I agree. I also think we can cook and make delicious food for them. Because if we mix a bit they don't know what's inside the food.
>
> (…)
>
> Jun: That's good. I think they just can keep trying eating. Maybe first they don't like it, but if they keep trying they can eat well. What about you, Do-hwan?
>
> Do-hwan: I like your idea. And my idea is if we explain why they eat various food, they will eat that way. We can also explain problems when they eat certain food only.
>
> (Group 3, Discussion, 9/1/2020)

In a discussion, children's communication focuses on a topic, and ideas emerge from group members' diverse knowledge and experiences of the topic. As a result, children are able to develop open-minded tolerance for different ideas. In the scene above, children were able to freely express their opinions. By encouraging classmates to express their opinions, the students created a supportive learning atmosphere in which they respected each other's opinions and received inspiration and stimulation from each other. Importantly, all this encouraged them to speak.

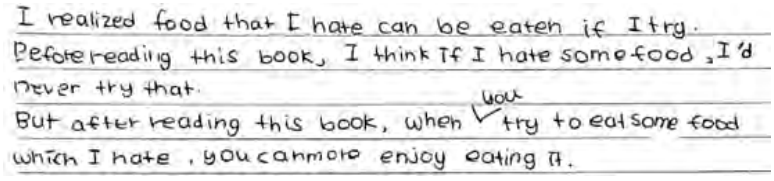
Next, the acceptance of other people's opinions was reflected in children's writing. Representative examples are as follows.


Before reading this book, I thought that my anger should be quietly resolved by myself. But now I think it's good way to go out side and stay calm.

(So-yeon, Journal, 9/14/2020)


what is squirter). I think when I think some food is another thing (something special), I think I can enjoy eating. Before reading this book, I think I will not eat Olive, but now I will think that is black holer and fry it.

(Mi-so, Journal, 8/31/2020)


I realized food that I hate can be eaten if I try. Before reading this book, I think If I hate some food, I'd never try that. But after reading this book, when you try to eat some food which I hate, you can more enjoy eating it.

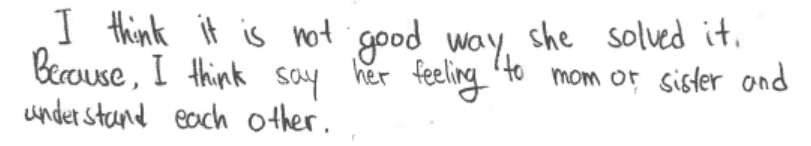
(Jin-seo, Journal, 8/31/2020)

In the example above, So-yeon changed her way of thinking about anger control management while exploring how the main character Sophie solves a problem in *When Sophie Gets Angry-Really, Really Angry....* And she expressed this change of thought in her journal using the expressions "Before" and "But now." After reading *I Will Never Not Ever Eat a Tomato*, Mi-so accepted Charlie's method and applied it to her own life, giving a new name to a dish she didn't like and trying it again. In the same context, Jin-seo showed an openness to changing her thoughts in line with the ideas presented in the book, using the expressions "Before" and "But after reading this book …." In this way, the open-minded approach of accepting new opinions and thinking flexibly, rather than insisting on one's own notions, helped the children think and write reflectively.

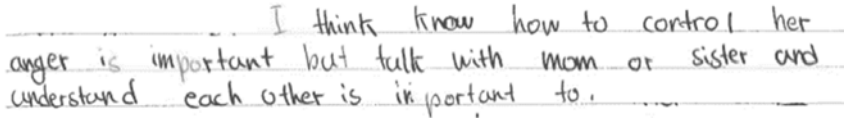
4.2.2. Language production according to change in independence

Through complex problem-solving activities involving children's literature, the children were able to develop independence, thinking actively on their own rather than just accepting the text or agreeing with the author in an uncritical manner. This tendency was mainly expressed in children's written language production. For example, they were able to criticize

the way the main character solved the problem and come up with written alternatives. Consider the following examples.



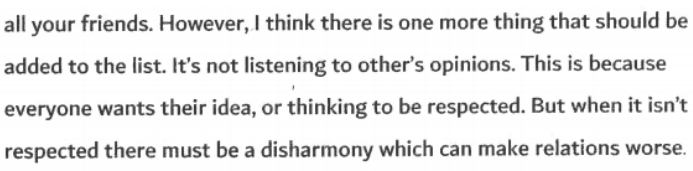
(Mi-so, Worksheet, 8/31/2020)



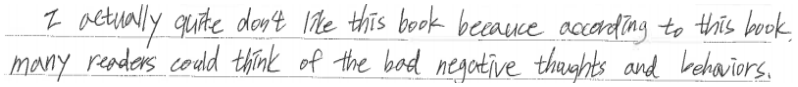
(Mi-so, Journal, 8/31/2020)

After reading *When Sophie Gets Angry-Really, Really Angry…*, Miso criticized Sophie's way of controlling her emotions and presented her own alternatives. And based on this activity, she was able to express her thoughts about the book in her journal. In this way, children were able to develop independence by questioning the problem-solving methods presented in the texts and expressing their opinions. This helped promote the children's written language production.

Next, the children were able to evaluate the books in writing on an equal position to the author. The following are journal entry extracts written by Dong-jun and Gyeong-gyu after reading *How to Lose All Your Friends.*



(Dong-jun, Journal, 9/18/2020)



(Gyeong-gyu, Journal, 9/18/2020)

Although Dong-jun agreed with the writer's suggestion about how to lose all one's friends, he went further and suggested additional content. On the other hand, Gyeong-gyu pointed

out that the method the author presented to help readers get along with their friends was not desirable. In this way, questioning the writer's thoughts and criticizing the text was more likely to be expressed in children's writing than in their speaking. This may be due to the fact that when they write, they have much more time to identify problems in the text and to criticize it rationally than during spoken discussions.

4.2.3. Language production according to change in objectivity

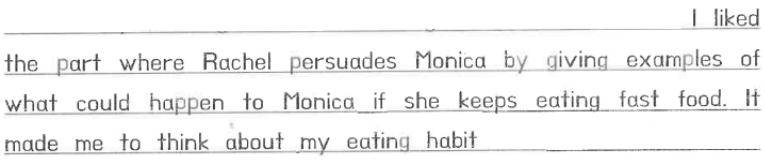
Through complex problem-solving activities involving children's literature, the children were able to reinforce their tendency to place importance on valid reasons or evidence. The tendency to recognize the importance of evidence when presenting opinions enriched the children's general language production, and the habit of considering rational accuracy mainly affected written language production.

First, children were able to enrich their speaking and writing by recognizing the importance of evidence when giving opinions. Jin-seo and So-yeon exhibited this sort of spoken language production while presenting and evaluating a problem-solving method related to the topic of resolving interpersonal conflict.

> I'm going to talk about how to build a good relationship. First, listen to others. When you listen to people around you, others will listen you well. Second, always be nice to people. Then, they will thank you. Finally, get rid out of greed. Because, petty quarrels and conflicts start with greed, and that leads to great conflict. So if you throw away your greed, you can get closer to people. (Jin-seo, Presentation, 9/29/2020)

> Jin-seo said listen to others, always be nice to people, finally get rid out of greed. I think this way is good way. Because she explained the reasons well.
>
> (So-yeon, Class discussion, 9/29/2020)

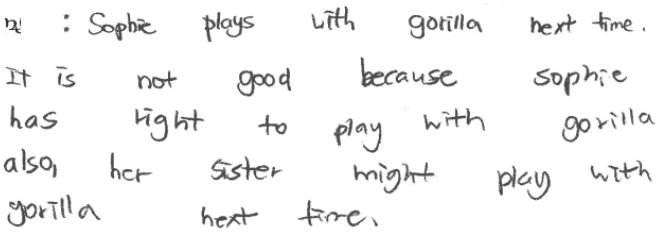
In the example above, Jin-seo gave her own opinion on how to form a good interpersonal relationship, and gave a presentation with evidence to support each idea. In response to this, while producing spoken language, So-yeon recognized the importance of the evidence while stating that Jin-seo explained the evidence well. In this context, Dong-jun mentioned the importance of evidence in the following journal entry extract after reading *Why Should I Eat Well.*


I liked the part where Rachel persuades Monica by giving examples of what could happen to Monica if she keeps eating fast food. It made me to think about my eating habit

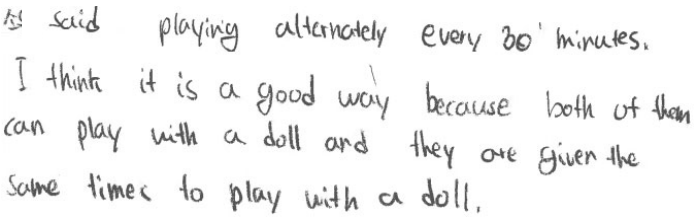
(Dong-jun, Journal, 8/26/2020)

In the example above, Dong-jun mentioned that it was impressive that Rachel gave various examples to persuade Monica to eat well. And because of this, he was able to look back on his own eating habits as well. In this way, it can be seen that written work was also produced that reflected a recognition of the importance of evidence.

Next, the attitude of considering rational accuracy before accepting other people's opinions affected the production of written language. During an activity in which children produced a video about how to solve a problem and shared the result, they watched videos made by classmates together in the classroom. Then they evaluated the problem-solving methods suggested in each video. The following extracts were written by Su-jin and Mi-so after watching videos produced by Dong-jun and So-yeon, respectively, about alternative solutions to the conflict between Sophie and her brother, who fight over a toy doll, in the book, *When Sophie Gets Angry-Really, Really Angry....*


: Sophie plays with gorilla next time. It is not good because sophie has right to play with gorilla also, her sister might play with gorilla next time.

(Su-jin, Worksheet, 9/29/2020)


said playing alternately every 30' minutes. I think it is a good way because both of them can play with a doll and they are given the same times to play with a doll.

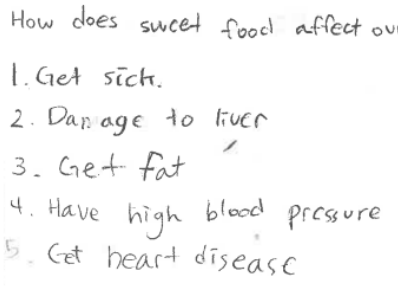
(Mi-so, Worksheet, 9/29/2020)

As can be seen above, the children listened to their friends' opinions and produced written language to evaluate their appropriateness based on the evidence. In other words, they were able to objectively examine opinions and express their support or disagreement in writing.

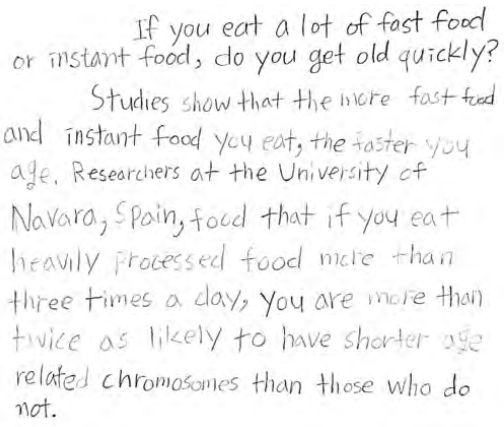
4.2.4. Language production according to change in inquisitiveness

Through complex problem-solving activities involving children's literature, the children were able to develop a tendency to explore various questions through their own initiative. This tendency promoted children's written language production and led to spoken language production based on writing.

First, the children were able to write about what they were curious about and their search for answers. The following examples of children's language production are related to this.



(So-yeon, Journal, 8/28/2020)

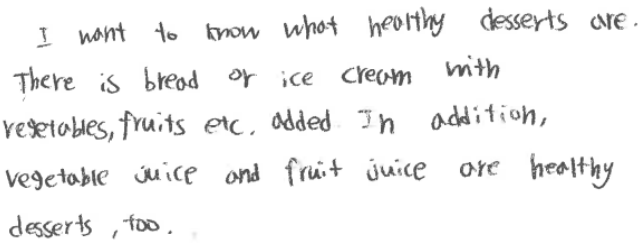


(Yeon-ju, Journal, 8/28/2020)

In the examples above, the children were able to solve the questions that had occurred to them while reading by using the internet to do research and by producing written texts using related information. So-yeon, whose English level is intermediate, wrote briefly about what she had discovered, while Yeon-ju, who has a high level of English, was able to find information related to what she was curious about and write about this in detail. In this way, the tendency to actively seek answers to the questions raised while reading and to problem-

solve helped children enrich their writing.

Next, the children were able to produce spoken language based on their writing. For example, Eun-ju recorded the questions that occurred to her while reading and the results of her research in her journal. Then, while participating in a group discussion to find ways to solve the problem, she could talk about what she had written in her journal.


I want to know what healthy desserts are.
There is bread or ice cream with
vegetables, fruits etc. added. In addition,
vegetable juice and fruit juice are healthy
desserts, too.

(Eun-ju, Journal, 8/28/2020)

Su-jin: I think we can cook and make delicious food for them. Because if we mix a bit they don't know what's inside the food.

Eun-ju: Yes, maybe we can make healthy desserts. (Looking at her journal) There is bread with vegetables and fruits. Also, vegetable juice and fruit juice are healthy desserts, too.

(Group discussion, 9/1/2020)

In her journal, Eun-ju wrote a question about what kind of healthy desserts there are using the expression "I want to know …." After finding some answers, she added them to her journal. This made it possible for her to present her ideas during the group discussion on how to solve the issue of an unbalanced diet. Spoken language production promoted by inquisitiveness was not improvised. Rather, it followed from researching related content and writing about this in English.

5. CONCLUSION

This study investigated how complex problem-solving activities involving children's literature can foster elementary school students' critical thinking dispositions and English production. The results are as follows.

First, complex problem-solving activities involving children's literature had a positive effect on the critical thinking dispositions of the participating children. As a result of the critical thinking dispositions test, positive changes in open-mindedness, independence,

objectivity, and inquisitiveness were found. The highest score among the four sub-areas of critical thinking dispositions was found for open-mindedness. In particular, the students had a strong tendency to listen to others' opinions, and the attitude of respecting others' viewpoints was nurtured. Independence was relatively low, but it saw the largest joint increase in score along with the score for objectivity. The tendency to question the author's authority was strong, and this tendency was further nurtured. Objectivity was the second highest score among the four. The habit of verifying evidence was particularly strong, and the habit of being wary of hasty conclusions was cultivated. Lastly, the lowest score was found for inquisitiveness, but there was a statistically significant change. Positive attitudes toward inquiry were strong, and based on this, it was possible for children to develop the motivation to raise a problem and search for answers on their own.

Second, the changes in the critical thinking dispositions enriched the children's English production. Considering the effect of changes in critical thinking dispositions on English production patterns, open-mindedness helped promote spoken language production since it encouraged students to share their opinions. In addition, understanding various viewpoints and accepting them was reflected in children's written language production. Independence was expressed in written language production, when students questioned the author's suggested problem-solving method or evaluated the text on an equal position to the author. Meanwhile, objectivity promoted spoken and written language production, with students recognizing the importance of evidence. It also helped children produce written language in order to examine the reasonable accuracy of other's opinions. Lastly, inquisitiveness promoted written language production as students considered various questions related to the text and wrote down their own findings.

The implications of this study for teaching English are as follows: First, complex problem-solving activities involving children's literature can aid in the development of target language production and critical thinking abilities. Various activities focusing on complex problem-solving can improve critical thinking dispositions, allowing learners to explore and solve problems based on their understanding of the text. This is in line with several studies that have shown that problem-solving is related to critical thinking ability (Sholihah & Lastariwati, 2020; Ültay, 2017). This study divided critical thinking into skills and dispositions and presented the positive changes in dispositions as objective figures. Moreover, this study highlighted the relationship between critical thinking and language learning, showing that the changes in critical thinking dispositions can facilitate the learner's spoken and written language production.

Second, even at the elementary level in the EFL context, language learning is possible through complex problem-solving activities. In other words, in situations where the opportunity to produce the target language is limited, problem-solving activities can promote learners' speaking and writing by providing a subject and context for it. This is consistent

with several studies in EFL fields that have shown that the problem-solving approach is effective in improving target language skills such as listening, speaking, reading comprehension, and writing (Danesh & Nourdad, 2017; Hussein, Roslan, Noordin, & Abdullah, 2012; Kim, 2019; Park, 2011). Unlike the approach taken by most of these prior studies, which presented statistical figures as results, this study included an in-depth analysis of the actual language output produced by learners in line with changes in critical thinking. This offers readers a clearer understanding of students' language production patterns.

Third, by using various genres and types of children's literature, it is possible to bring about a number of positive changes in the critical thinking dispositions. For example, in this study, children did not show significant improvement in understanding other cultures in terms of open-mindedness, which could be related to the content of the selected texts. In relation to this, multicultural picture books can develop open-mindedness and inquisitiveness by broadening learners' understanding of other cultures and motivating them to explore the new culture (Park, 2021).

Regarding the limitations of this study, this study focused on presenting children's English production reflecting their critical thinking dispositions, so there was no comparison between before and after intervention or between a comparison group and an experimental group in terms of language production. In addition, the experimental class was conducted for about six weeks, which is a short period of time, and it was difficult to present the development of children's productive language skills quantitatively. In terms of critical thinking abilities, it is necessary to examine whether the changes in the dispositions presented in this study are long-lasting. It is expected that further in-depth studies on developing learners' critical thinking and target language ability together will be attempted in various contexts.

Applicable levels: Early childhood, elementary

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