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5. The effectiveness of educational practices for developing critical thinking skills in basic school students: A Systematic Review

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Abstract

This systematic review focuses on identifying educational practices of any school subjects that can develop critical thinking skills in basic school students of emerging and developing countries. The inclusion and exclusion criteria were created. Among them, we only selected the experimental design or quasi-experimental design to get the effect of the educational practices on the critical thinking skills compared to the traditional approach. The published literature included the effectiveness of learning programs, approaches, models, and techniques used in basic education. In total, 11 articles published in English placed this geographic context were selected. The reviewed studies were published from 2016 to 2021. The results indicate that the innovative educational approaches experimented developed more critical thinking skills in students than expository teaching. Moreover, the published articles offer a window of the type of educational practices used in the fields of science, mathematics, literacy, social sciences, and interdisciplinarity. This study concludes that these educational practices are designed to enhance student instruction and focus education on 21st cycle skills, including critical

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thinking.

Keywords: *Critical thinking skills, primary school, emerging country, experimental design, systematic review.*

Introduction

Over the past two decades, the advent of a global movement in education calls for teachers to prepare and equip students toward new learning goals (Teo, 2019; Afrida, Rc & Utanto, 2019). Teo (2019) states that students must be helped to be functional in this increasingly globalized and interconnected world. This researcher argues that it is therefore necessary for teachers to provide a holistic education that emphasizes life skills such as communication, cross-cultural collaboration, and critical thinking. Nasheeda, Abdullah, Krauss and Ahmed (2019, p. 363) specify that "the goal of life skills education is to equip individuals with appropriate knowledge on risk-taking behaviours and develop skills such as communication, assertiveness, self-awareness, decision-making, problem solving, critical and creative thinking." In addition, Afrida et al. (2019) also mention that the skills to be acquired must prepare learners to think, learn, work, solve problems, communicate, collaborate, and actively contribute. These authors emphasize that this shift therefore calls for changing formal education to new forms of learning through models, programs, and processes that address the complex global challenges of the 21st century.

In this regard, according to Syah et al. (2019), to be able to improve the quality of learning, teachers must improve students' critical thinking. Thus, teachers are tasked with implementing effective learning to motivate students to be able to think critically and logically to solve problems. Elsayed and Abbas (2021) specify that to develop students' minds, education provides the ability to conclude, imagine, invent, create, and critique. In other words, it is necessary to develop students' abilities to employ methods of mental processing of acquired knowledge.

Under these circumstances, this concern towards the development of thinking skills takes an important place in academic work and solicits the involvement of many experts and researchers in education (Elsayed & Abbas, 2021). In order to enable students to meet local and global challenges in different fields, a large amount of writing and research has been done in education to develop,

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develop and adopt new learning programs. According to Elsayed and Abbas (2021), critical thinking is one of the most important types of thinking. This is because it helps learners evaluate the quality of information and ideas they encounter. Therefore, in this context, this article focuses on the development of critical thinking in learning programs.

2. Theoretical Framework

2.1 Critical thinking definition

Several authors characterize critical thinking. Aslan and Aybek (2020) define it as an intellectual activity that is not random, but rather a way of thinking about the basis of a problem. They explain that critical thinking requires analyzing different perspectives to the problem in order to understand them and take a position by opposing or affirming the information. Furthermore, they raise a relevant definition that describes critical thinking as "analyzing facts, producing thoughts and organizing them, defending views, making comparisons and inferences, evaluating argumentation and an ability to solve problems" (p. 22). Elsayed (2016), as well, supports the idea of reflective thinking that emphasizes decision-making faced with individuals' actions and ideas of thought. Lestari et al. (2021, p.1-2) define that "critical thinking involves the process of actively conceptualizing, applying, analyzing, and observing a problem derived from observation, experience, and communication in contrast to passive thinking which analyzes something based only on the facts available without trying to connect with other things." Syah et al. (2019) agree that critical thinking is the key skill required to solve problems responsibly and thoughtfully to present and future challenges. They characterize it as a reflective mental activity that allows one to logically evaluate arguments in decisions. According to these researchers, unlike other types of intelligence, critical thinking can be improved and developed without depending on age.

2.2 Critical thinking skills

Lestari et al. (2021) distinguish the characteristics of the critical thinker from the passive thinker. According to these researchers, the passive thinker adopts a limited and egocentric worldview. This is explained by using affirmative (yes) or negative (no) answers and the consideration that only their

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views and facts are relevant and sensible. In turn, "critical thinkers are characterized by asking important questions and problems, formulating them clearly, gathering and assessing relevant information, using abstract ideas, being open-minded, and communicating effectively with others" (2021, p. 1). Elsayed and Abbas (2021) mention that critical thinking is one of the most significant types of thinking. In line with the definitions presented, they explain that it is a mental process that the learner performs when faced with a specific problem. The skills developed in critical thinking allow him/her to practice a series of successive mental skills in a logical and organized way. These skills allow him to evaluate and judge the components of the problem. In this way, he benefits not only for solving the current and specific problem, but also when faced with future problems (Elsayed & Abbas, 2021). In accordance with critical thinking skills when dealing with specific problems, these authors also emphasize the process of critical thinking when people are confronting values, customs, and traditions of the society, whether inherited or imported. In these circumstances, critical thinking skills enable the learner to distinguish between positive and negative elements of the information he or she receives, to reconsider and judge it to adopt what is consistent with his or her values.

Despite the multitude of opinions and viewpoints found in the literature on specifying critical thinking skills, Elsayed and Abbas (2021) focus on these five skills: (1) knowledge of assumptions and postulates, (2) interpretation, (3) deriving, (4) deduction, and (5) estimating arguments and discussions. The first skill, knowledge of assumptions and postulates, involves examining the implications and data on people's beliefs to judge certain assumptions as probable or improbable. The second skill, interpretation, estimates evidence and distinguishes between justified and unjustified data and instructions to establish a probable and justified conclusion. It also allows one to reasonably draw specific conclusions from assumed facts. Through the ability to know and specify relationships between specific incidents, the third skill, deriving, represents the judgment of individuals to determine whether a particular conclusion is derived from certain premises. The deduction skill consists of determining the truth of certain conclusions from the linking of a bank of data and information offered to the individual. The last skill, estimating arguments and discussions, means the ability of individuals to distinguish between strong and weak arguments on a subject.

Syah et al. (2019) state that a critical thinker must have a good understanding of the situation as well

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as the ability to use the neutrality effect in reconsidering and evaluating the problem. However, they point out that it is a process in which individuals analyze confrontations that are not easy to solve where, very often, there is not all the necessary and relevant information available to respond in a rational way. Thus, these authors raise the importance of training high-level critical thinking skills in students starting in elementary school. Instituting critical thinking skills as a new global learning goal requires a consideration of critical thinking criteria to adjust learning approaches to the exacerbation of complex problems in modern international life (Syah et al., 2019). According to Lestari et al. (2021), several research conducted on critical thinking at school level raise the importance of opting for strategies that actively involve students in the learning process. These authors state that for the improvement of critical thinking skills, students need to focus on the learning process rather than on the content alone. In addition, the use of assessment techniques to challenge students intellectually is more challenging for critical thinking skills than memory assessments. In this context, the purpose of this article is to examine the effectiveness of learning programs on the development of critical thinking skills in elementary education.

3. Method

As stated by Khan and colleagues, "a review earns the adjective systematic if it is based on a clearly formulated question, identifies relevant studies, appraises their quality and summarizes the evidence by use of explicit methodology" (2003, p.118). To meet the objective of this article, this research follows the five steps for conducting a systematic review of these authors. These steps are as follows: (1) framing the question; (2) identifying relevant publications; (3) assessing study quality; (4) summarizing the evidence; and (5) interpreting the findings.

3.1 Research questions that guide the systematic review

The following research questions provide a guide to our systematic review of the literature. (1) How can critical thinking be improved and developed in elementary school students? (2) What learning program enhances critical thinking in elementary school students? (3) What approach or model is effective in developing critical thinking skills in elementary school students?

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3.2 Review of the literature: database, descriptors, and inclusion criteria

The literature review comprised a search of bibliographical databases, such as Science Direct, ResearchGate, Education Resources Information Center (ERIC), and Scopus. Furthermore, articles were searched on Google Scholar and Google. The corpus has been delimited by the triangulation of the selected databases and using Boolean operators such as “and”, “or”, “near” and “*”. Here are the search terms by categories:

Table 3.1

Terms selected by categories

<i>Categories</i>	<i>Content</i>	<i>Population</i>	<i>Context and geographic criteria</i>
<i>Terms</i>	Critical thinking	Primary school	Developing countries
	Critical thinking	Elementary school	Emerging countries
	skills	Basic education	Global south
	Critical thinking	school	South
	program		Oman
	Developing critical		Middle East countries
	thinking		Arabic countries
	Critical thinking		North Africa
	education		

To select the most recent research in the field, the search refers to articles dated within the last five years, between 2016 and 2021. The inclusion criteria consisted of scientific primary studies with the following characteristics: (1) English or French articles; (2) experimental design or quasi-experimental design; (3) assesses the development of critical thinking skills through experimentation of a learning program, model, approach, technique; (4) pretest and posttest on critical thinking; (5) placed in a geographic context as Oman country, Asia, Arabic countries and the Middle East countries (emerging and developing countries); (6) placed in the field of basic education, primary school or elementary school; (7) unpublished manuscripts were excluded; (8) comprising the full text;

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and (9) only peer reviewed publication.

3.3 Review progress

In the first round of the review process, 243 papers were screened, and more than half have been eliminated. These were excluded from the title of the article that clearly did not fit in the chosen criteria. After this first process, 74 remaining articles were analyzed to select the data collection. Some of them were excluded because of the educational level of the population, others were cancelled because of the type of research that was not experimental. Some of them did not have the full text or wasn't available. Hence, a list of 11 papers comprises the final sample of the literature that meets the inclusion criteria. To organize the coding system, a data collection tool was developed to relevant the characteristics of the studies with respect to the contextual and methodological variables.

3.4 Coding system and type of analysis

To analyze the 11 selected papers, on one side, the coding system established is based on the contextual variables, including (1) authors and publishing year; (2) type of date; (3) population and context (geographic origin and education level). On the other hand, the coding system considered content and methodological variables, including (4) study design (research methodologies as reported); (5) instruments; (6) interventions or exposures of the critical thinking; and (7) main outcomes and investigated outcomes (or results). All those variables were analysed descriptively using EXCEL.

The process of analysis involved the identification of patterns of similar ideas, concepts, and topics on the result of the data collection. It also includes the specified relevant elements. This process establishes the connection and integration of information with the theoretical foundation and to track any evidence of contextualization. Thus, all recommendations will be evaluated based on the strengths and weaknesses of the evidence. Furthermore, the synthetic analysis is about analyzing themes to go beyond the findings of the primary studies and generate additional concepts, understanding or hypotheses.

4. Findings

General characteristics of the studies

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The 11 articles that met the inclusion criteria were published between 2016 and 2021. The low ratio of recruited articles reflects the novelty of this research interest. Thus, testing the effectiveness of new learning programs on the development of critical thinking in elementary school in these contexts is not widely known. According to the collected database, one article was published per year in 2016, 2018, and 2019. Subsequently, four articles were published in 2020, as well as in 2021. This increase in publication over the past two years underscores the beginning of a growing interest in measuring the effects of new programs addressing critical thinking skills.

Of these 11 papers, more than half were published in Indonesia, 7 articles. This distinction reflects the country's interest in the influence of learning programs on the critical thinking in basic school. Two other countries have been published, two papers in Oman (2016 and 2021) and two papers in Turkey (2020, 2021). This represents four papers in the Middle East region between 2016 and 2021 and seven articles in Indonesia from 2018 to 2021.

These studies were mostly developed with elementary school students of grade 4 and grade 5. Four articles were conducted in grade 4 and five with students of grade 5. One article was in grade 6 in basic school in Oman, and one paper was in grade 7 in primary school in Indonesia. A particular interest in the development of critical thinking skills of students from 9 to 11 years old can be analyzed by the grade level of the participants. No research has targeted in early grade levels of elementary school.

4.2 Studies purpose

All research has addressed different elements to assess and measure the development of students' critical thinking skills. This research has examined approaches, techniques, instructional models, and programs for teaching different subjects in elementary education. In this research, science, mathematics, literacy, social studies, multiculturalism, and interdisciplinary activities are the school subjects addressed.

In Rizqiyana (2021) paper, they research the learning approach STEM using thematic learning media in developing the critical thinking skills of elementary school students. The approach STEM stands for Science Technology Engineering and Mathematics in situations that can be felt in real life.

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Elsayed and Abbas (2021) use of the Six Thinking Hats technique in teaching mathematics led to the development of critical thinking skills and numerical sense.

Meral et al. (2021) investigated the relationship between students' critical thinking disposition and argumentation skills in seventh grade social studies. They used the argumentation-based teaching (ABT) approach to examine those skills.

Puput (2021) used contextual teaching and learning (CTL) to study students' ability improvement and character building by analyzing the effectiveness of mathematics comic book containing Pancasila values as teaching material. Pancasila are five principles who represent the character of the Indonesian country: religiosity, humanity, unity, democracy, and justice.

Aslan and Aybek (2020) examine the effect of Interdisciplinary Curriculum-Based Multicultural Education on tolerance attitude scale, critical thinking skill and tolerance scoring rubric. This included Social Sciences, Turkish, Mathematics, Foreign Language, Visual Arts, Music, Religious Culture, Physical Education subjects. Multiple's activities were prepared and implemented addressing themes of social issues, including Individual and Society, Gender, Ethnic Identity and Genealogy, Language, Faith, Socio-Economic Situation, Disability. The class participant has a multicultural structure where students have different cultural characteristics and socioeconomic levels.

Ardhian et al. (2020) compare two techniques of reading with high critical thinking and low critical thinking. The first technique of reading is Directed Reading Thinking Activity and the second one is reading Preview, Question, Read, Reflect, Recite, and Review Technique.

Khairani et al. (2020) experiment the influence of collaborative problem-based learning (PBL) model and motivation to students' critical thinking skills. The content of the experiment is in science subjects.

Of these 11 articles, 4 address an approach to improving critical thinking in science and 3 articles are on teaching math with elementary students. Although these articles are in the same academic areas, they do not address the same concepts.

For the areas of social studies, literacy, and multiculturalism-based interdisciplinary instruction, there is only one article for each topic. The social values discussed in the social study (Meral et al., 2021)

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and the Interdisciplinary Curriculum-Based Multicultural approach (Aslan and Aybek, 2020) have similar values and learning orientations. The article on Interdisciplinary Curriculum-Based Multicultural is the only one that specifies the importance of social criteria in the participants. This is due to the desire to have a socially heterogeneous group to address social conflicts with students.

The article on reading (Elsayed and Abbas, 2021) is the only one that compares two different techniques, one called experimental and the other more traditional, called control. Three articles use the collaborative problem-based learning (PBL) model to assess students' critical thinking. Two of them focus on science, while the other one deals with life skills. On the other hand, 6 articles anchor the content in real-life situations.

4.3 Methodologies used

All the articles are quantitative research. Seven of the eleven research are quasi-experimental and 4 are experimental. Two quasi-experimental studies used the single group pretest-posttest design to evaluate the specific intervention of learning (Aslan and Aybek, 2020) or approach (Rizqiyana, 2021) on the development of critical thinking skills. Five groups used the traditional two-group classroom method. This included an experimental group that treated the evaluated program and a control group where students received expository instruction. One paper (Ardhian et al., 2020) also used the traditional two-group class method to compare the data, but with the 2x2 ANOVA treatment. In this study, there was the experimental group who evaluated the Directed Reading Thinking Activity technic and the control group who evaluated the reading Preview, Question, Read, Reflect, Recite, and Review Technique. Another study (Trisdiono et al., 2019) is a quasi-experimental with 2X2 factorial design who has two groups, one experimental and the other a control group. To increase the reliability of the study, the teacher was an observer in the experimental group and in one group control during the actual implementation. Two papers used three class groups to evaluate the effect of their research. The first one consisted of one experimental group and two control groups. In the second paper, Amrullah and Suwarjo (2018) presented two experimental group and one control group. In 10 articles, there were between 23 and 35 students' participants in each group. Only one research had 60 students as participants in the experimental group and 59 students in the control group. To

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validate the instruments, most of the research used other class groups beforehand. The validity of these instruments was done by the validation of the content and reliability of the test items by experts, professors, and teachers. The selected class for this test trials was usually on class groups of the same level.

4.4 Instruments and tools

All research studies used a data collection tool to measure the development of critical thinking skills in the pre- and post-test periods. However, none of the research used the same measurement tool. Seven of the eleven articles specified criteria for specific critical thinking skills. These skills can be found in the articles: knowledge of assumptions and postulates; interpretation; deriving; deduction; estimating arguments and discussions; inference.

Only two articles used existing tests as the basis for their research. However, the researchers adapted the instruments to the context. The first instrument is the University of Florida Engagement, Maturity, and Innovativeness Critical Thinking Disposition Instrument (UF/EMICTDI to measure students' critical thinking disposition. This tool was used in Meral et al. (2021) article. The second tool is Watson-Glaser's Critical Thinking Appraisal instrument (Watson & Glaser, 2002). This tool is used in the research of Puput (2021).

Two articles did not specify the source of their instruments. This is the case for the research of Trisdiono et al. (2019) and Khairani et al. (2020). The first research uses two instruments for observing critical thinking skills, one in pretest and one in posttest. The 2nd article presents aspects of Critical Thinking Skills in a table, without specifying study Materials and Tools. This weakens the reliability of this research. On the other hand, in the data collection set, 9 articles confirmed to have ensured the validity and reliability of the tests. Among these, two are existing tests that have had some modifications to comply with the context. The other seven articles built the measurement instruments according to the needs and objectives of the research. These tools were validated by faculty members, teachers at primary school and experts. These tests were also validated by using students of similar grade level to the project participants. Thus, the researchers were able to use statistical tests to confirm their validity and reliability before being implemented in the project.

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Several articles also measured other skills in their research. Elsayed and Abbas (2021) developed a test to measure the level of possession of 6th grade students' numerical sense. Meral et al. (2021) rank into five levels of the arguments the six weeks' activities for analyzing the relationship between students' argumentation skills and critical thinking. Puput (2021) used a questionnaire of discipline and hard work character traits using the Guttman scale. Aslan and Aybek (2020) used trois items: (1) Tolerance Attitude Scale, (2) Tolerance Value and Critical Thinking Skills through Story Test and (3) Critical Thinking Skill and Tolerance Scoring Rubric. Aiman, Hasyda and Uslan (2020) also evaluated the scientific literacy. Amrullah and Suwarjo (2018) used test and scale for evaluated critical thinking skills and interpersonal intelligence. Elsayed (2016) used an academic achievement test to evaluate the content of the unit and problem solving in mathematics.

Some researchers also confirm the validity and reliability of the material used during the intervention. Elsayed and Abbas (2021) prepared a teacher's guide based upon the Six Thinking Hats Technique. Aslan and Aybek (2020) prepared and implemented to the students an interdisciplinary curriculum based on multicultural education. Elsayed (2016) developed and validated a student's book and a teacher's guide according to Elaboration Theory.

4.5 The results of the effects of the studies

This section first presents the results of the eleven articles as well as the reasons that demonstrate the effectiveness or ineffectiveness of the educational approaches evaluated. Subsequently, based on the results of the studies in the data collection, an analysis of the similarities and differences between the research will be presented.

Based on the data analysis done with the t-test, Rizqiyana (2021) concluded that the result of the post-test group has moderately better critical thinking skill than the result of the pretest group which both received the learning of STEM approach using thematic learning media. The results of the study show that the students' critical thinking skills improve as the approach allows them to easily understand concepts by increasing the logic of the given problems. This allows them to analyze situations to make choices and draw intelligent conclusions using their critical thinking skills. Thus, the learning process includes the process of interpreting, analyzing, evaluating, concluding, and explaining

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according to the knowledge area that can think critically.

The results of Elsayed and Abbas' (2021) study clearly demonstrate that the Six Hats of Thinking technique was very effective in developing critical thinking skills and numerical sense within the study sample. With respect to critical thinking skills, the authors raise several reasons for this effectiveness. First, this technique allows for the linking of different types of information which develops several critical thinking skills such as interpretation, classification, discrimination, deduction, conclusion, and evaluation. Second, motivation to strive for excellence, criticism, creativity, and competition are elements that the six hat techniques may have fostered. Third, this technique asks students to play a significant role in the classroom, soliciting the opportunity to excel, critique, and practice different and varied ways of responding. Fourth, this educational process motivates the student to be active, participatory, and reflective. Fifth, the Six Hats of Critical Thinking technique has been effective in stimulating the level of ambition among students, awakening their attention, and motivating them to continue the activities. Finally, the authors present several studies that demonstrate that critical thinking skills are developed when teaching mathematics through other approaches.

Meral et al. (2021) raise a positive relationship between argumentation skills and critical thinking disposition. This is due to the variable of argumentation skills which in this study was a predictor of critical thinking skills. Thus, according to these results, students with high argumentation skills also have high critical thinking disposition and use their critical thinking skills more effectively. This research asked students to have discussions about conflicting issues without compromise given. Based on the research findings, this type of questioning and discussion contributes to students' thinking skills, such as approaching, questioning, making decisions with a different point of view, and developing critical thinking skills. In support of the literature on the topic, students must learn to support their claims and ideas on issues using argumentation processes such as the assertion, data, justification, support, and refutation. In addition, they must learn to create ideas for rebuttal when a claim is not valid. These authors emphasize the vitality of this type of activity to develop the desired level of skill.

In Puput's (2021) research, the difference in mean score (N-Gain) between the experimental class and

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the control class demonstrates that using comic books as materials to teach mathematics did improve students' critical thinking skills. However, the results show that both groups had an increase in critical thinking development. The students in the experimental group were also one better than the control group on the pretest. The N-Gain of the experimental class, however, is higher than the control class, despite their average grade level. The control class having had expository learning and worked in a notebook is also beneficial for improving students' critical thinking. The author states that the use of comics as a material for teaching mathematics stimulates students to study harder, to improve their performance because students are attracted by the visual of the comics. Thus, what emerges from this research is that students with a high level of discipline and hard work also have a higher critical thinking ability.

The t-test analysis of Aslan and Aybek's (2020) study demonstrate a statistically significant difference between students' pretest and post-test scores for the critical thinking skill. The effect size indicates that this difference is very high. He agrees that the multidisciplinary education program based on multicultural education is very effective in developing students' critical thinking skills. The various types of activities and teaching approaches worked with the students in this research explain the improvement of this skill. This educational program includes cooperative learning, subject matter instruction in critical thinking skills as well as conducting the course through research, guidance, question, and answer technique, taking students' opinions on multiple topics and actively engaging them. According to the authors, with these activities, students learn to understand events and situations from different angles, to make deductions, to investigate problems encountered, to understand and analyze situations and to take a stand to defend their point of view and solve problems.

Ardhian et al. (2020) explain that the reading learning technique of the Directed Reading Thinking Activity of the experimental class is more influential than the reading learning techniques of the learning, learning, reading, thinking, reciting, and reviewing of the control class for reading comprehension skills. This is due to the higher average score of students with critical thinking skills in the experimental class than in the control class for reading comprehension skills. On the other hand, the directed reading technique is the most appropriate one to improve students' reading

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comprehension skills. The learning technique of the experimental class is more appropriate for students with strong critical thinking skills and the technique of the control class is more appropriate for students with weak critical thinking skills.

Khairani et al. (2020) conclude that students' critical thinking skills have a better mean value with the problem-based collaborative learning model than the direct learning model. In addition, the results show that the critical thinking skills of highly motivated students are better than those of low-motivated students. Finally, the authors state that students' learning styles and motivation influence each other and play a role in their critical thinking.

Aiman et al. (2020) conclude that there is a significant difference between students' critical thinking and scientific literacy through POGIL learning assisted by real media than through expository learning. Thus, this type of approach influences scientific literacy and critical thinking. POGIL real media assisted learning is a model that makes the student active in working in teams, capable of solving problems and developing critical thinking skills. This model is student-centered in contrast to the expository teaching model. The latter is teacher-centered and makes the student less active in learning.

Based on the results of Trisdiono et al. (2019) study, integrated multidisciplinary project-based learning can improve students' critical thinking skills and collaboration. The learning process of project-based integrated multidisciplinary improves students' critical thinking skills because it allows them to learn to think.

Amrullah and Suwarjo (2018) show that the three groups' pretest scores were similar, but that the post-test scores were very different. The experimental groups receiving the problem-based cooperative learning model treatment in the natural science subject thus shows different descriptive statistical results than the group with an expository learning model. The implementation of problem-based cooperative learning in the natural science subject area was effective in improving the critical thinking and interpersonal intelligence of fifth grade students. Instead, this learning model is effective in improving critical thinking and interpersonal intelligence skills. Therefore, this model contributes positively on students' natural science skills.

Elsayed (2016) states that the organization of mathematical content based on elaboration theory

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promotes the organization of knowledge in the student's mind, which leads to the development of critical thinking as well as academic success. The goal of elaboration theory is to provide details about new information by making it meaningful and using it effectively in educational contexts. This theory allows for the creation of relationships with the content of the concept to facilitate learning by minimizing the occurrence of comprehension errors. Finally, the author points out that elaboration theory helps the student understand the relationships between information and critical thinking skills. This takes shape through interpretation, classification, discrimination, deduction, conclusion, and evaluation.

Among all the papers, three research had very high efficiency results (Amrullah & Suwarjo, 2018; Trisdiono et al., 2019; Elsayed & Abbas, 2021). Five studies found significant high-level differences describing the experimental tool as effective (Meral et al., 2021; Aslan & Aybek, 2020; Khairani et al., 2020; Aiman et al., 2020; Elsayed, 2016). Two of them were noted to have a medium level of effectiveness (Rizqiyana, 2021; Puput, 2021).

Unlike the other articles where the approach treated in the experimental group was statistically significantly better than the results of the control class, the research of Ardhian et al. (2020) demonstrates another result. In this one, neither model is significantly better overall. However, with students with high-level critical thinking skills, the experimental class using the Directed Reading Thinking Activity technique was significantly effective for their learning. For students with low-level critical thinking, it was the Learning, Reading, Thinking, Reciting, and Reviewing technique that was significantly effective.

5. Discussion and Conclusion

This systematic review examined the published literature on the effectiveness of learning programs, approaches, models, and techniques on the development of critical thinking skills in elementary school students. The geographic context of the articles selected was in developing and emerging countries, in the Middle East, Asia or the Global South. The results reveal that the use of innovative approaches in education is necessary to promote critical thinking skills in schools. In contrast to



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traditional, expository teaching, these new approaches provide a variety of ways to teach different academic areas at the primary level. These approaches are designed to enhance student instruction and focus education on 21st cycle skills, including critical thinking.

The review revealed only quantitative studies examining approaches that promote the development of critical thinking skills in elementary school. The development of this type of research is important for understanding and evaluating the effects that new learning can have. Promoting learning practices that foster the development of 21st cycle skills is helpful in providing students with a globalized and internationally interconnected education (Teo, 2019).

This review examines research that specifically addresses the development of critical thinking skills in elementary school students, which is one of the life skills to be developed for the 21st cycle. Consequently, many articles also used pedagogical practices that address other life skills. Communication and intercultural collaboration have been addressed in some studies, which demonstrates the interest of researchers in renewing education towards new horizons of international education.

The review of the different articles offers a window of the type of approach used in the fields of science, mathematics, literacy, social sciences, and interdisciplinarity. This research focused on students between grade 4 and grade 7 of the primary level. It would be interesting to pursue research on educational practices that allow for the development of critical thinking in primary grades 1 to 3 and even in preschool.

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