

Think-Pair-Share and Roundtable: Two Cooperative Learning Structures to Enhance Critical Thinking Skills of 4th Graders

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Abstract

Critical thinking skills are essential for success in life and work, and it is essential that learning strategies enable the development of critical thinking skills from the early years of schooling. The objective of this study is to evaluate the effectiveness of cooperative learning using the RoundTable and Think-Pair-Share methods in the development of critical thinking skills such as observation, inference making, interpretation, analysis, and argumentation, in 4th graders students. The study employed a quasi-experimental design with a pretest and posttest using equivalent experimental and control groups. Results show that the use of cooperative learning, compared to a more traditional teaching methodology, was more effective in developing the critical thinking skills under study.

Keywords:

Cooperative Learning, Think-Pair-Share, Roundtable, Critical Thinking Skills, Four-Grade Students

Introduction

In everyday life we are forced to make countless decisions. Most of the time we end up doing that automatically and spontaneously, since our brain uses mental shortcuts to save energy (Kahneman, 2011). However, if we think critically and deliberately while situations occur, we are more likely to make better decisions, which in turn will affect our lives (Butler, 2012).

Decisions are often made based on how we treat information. In a world where information has become increasingly accessible due to technological developments, it is essential that people develop skills such as organizing and selecting the information that is made available, as not all of it is credible, important, or even reliable (American Management Association, 2012; Stobaugh, 2013). Individuals must be able to critically evaluate the information to which they have access so that they can select the valid, reliable and important information, discarding those that are not, always keeping in mind the objective that they intend to achieve with that information (Schneider, 2002). This requires critical thinking skills, considered indispensable



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for success in life and work in the world we live in. Associated with this competence, communication, cooperative group work, and creative thinking are also necessary conditions for children to become self-determined, participative, and free citizens (Johnson & Johnson, 2014; Vansieleghem, 2005; Partnership for 21st Century Skills - P21, 2011; OECD, 2018).

Critical thinking has been characterized as being a structured thinking that allows one to avoid making crucial mistakes and that promotes the generation of ideas and solutions to problems that expand the opportunities for success (Massa, 2014). For Ennis (2015), critical thinking is "a rational, reflective thinking focused on deciding what to believe or what to do" (p.15). It is thus viewed as the personal ability to think for oneself reliably and to make responsible decisions that may affect individuals' future life (Ennis, 2015). For Halpern (1999), critical thinking is purposeful, rational, and goal-oriented thinking. It is a type of thinking that is involved in problem solving, in formulating inferences, calculating probabilities, and making decisions (Azmat, 2016; Cruz et al., 2019; Facione, 1990; Klimovienė et al., 2006; Molina-Patlán et al., 2016).

For Florea and Hurjui (2015), critical thinking is a complex cognitive process that is related to language and is developed through activities that for younger students involve reading, writing, speaking, and listening. The authors also point out that critical thinking is the result of the product of interactions between ideas and information.

The importance of interactions for the development of critical thinking makes cooperative learning a good strategy for its development (Gokhale, 1985; Wincel, 2013). Cooperative learning is a teaching and learning strategy in which students organized in small heterogeneous groups, in terms of academic achievement and gender, cooperate with each other by evaluating the performance of their group, in order to achieve common goals (Johnson & Johnson, 2014; Lopes & Silva, 2009; Slavin, 1995). To this end, each member of the group is responsible for learning, as well as for contributing to the learning of the other members of the group, creating an atmosphere in which everyone feels fulfilled (Balkcom, 1992).

According to Johnson and Johnson (2016), cooperative learning groups' work is based on five basic elements: positive interdependence, individual and group accountability, promotive interaction, social skills, and group processing. These characteristics make each of the group members individually stronger through collaborative learning, that is, students learn together to get stronger and better individually (Lopes & Silva, 2009). Positive interdependence is based on the conviction that the success of each member is linked to the success of the group, and that the group is only successful if all members are successful (Cecchini et al, 2020; Johnson & Johnson, 2005); individual and

group accountability allows the group to reduce the possibility of one member taking advantage of the work of others. In order for the group to achieve its goals, its members divide tasks or perform roles and each one is responsible for doing their part well (Johnson & Johnson, 2002; Silva, Lopes, & Moreira, 2018; Slavin, 1995); promotive interaction, preferably face to face is the essential condition to move from individual group work to group work, since working in groups requires that, during the tasks performance, students promote and facilitate each other's learning, through mutual help and support and stimulation of the efforts that each one makes to learn (Johnson & Johnson, 2002; Silva et al. , 2018; Slavin, 1995); social skills - students must possess the social skills necessary for cooperation, as these enable them to work effectively in groups. Candler (2021) states that a lack of social skills is probably the main inhibiting factor to success of cooperative groups. Examples of basic social skills are, speaking each in turn, listening attentively, managing conflict, making decisions, respecting the opinions of others (Johnson & Johnson, 2009; Lopes & Silva, 2009; Silva et al., 2018); group processing - the effectiveness of cooperative learning depends largely on the establishment of evaluation procedures that serve to regulate the groups' performance. Each member of the group individually and the group as a whole reflect on their own functioning, on how to overcome difficulties and resolve conflicts. This allows the group to become more autonomous and effective in achieving common goals (Johnson & Johnson, 2002; Johnson & Johnson, 2009; Silva et al., 2018). When these five characteristics are present in the functioning of a cooperative group, students share and synthesize ideas, argue about their points of view, and establish agreements, thus promoting critical thinking skills.

Cooperative learning group activities require students to confront different perspectives and analyze their importance so that they can synthesize information and negotiate to reach agreements. Paul and Elder (2001) and Dennicka and Exley (1998) argue that group discussions are effective in the sense that they stimulate thinking and develop ideas. For Paul (1995) when students are in groups discussing and arguing their views, they are developing critical thinking. For the European Commission (2007) and Fitzgerald (2012) it is very important that students are engaged in learning activities that involve making observations, analyzing, explaining, asking questions and planning, all of which are skills associated with critical thinking. Johnson et al. (2008), Patesan et al. (2016) and Valverde and Navarro (2017) claim that cooperative learning brings students the opportunity for students to develop new learning attitudes, as they become the center of their learning rather than assuming a passive attitude of mere recipients of knowledge (Cunha & Uva, 2017; Johnson & Johnson, 2016).

There are several cooperative learning techniques that promote students to participate in group

discussions, to confront information, think critically about issues and to be able to defend them (Facione, 2000). Think - Pair - Share (TPS) enables great oral and written argumentation, the discussion of different perspectives, and increases the quality of responses by increasing the waiting time (Johnson & Johnson, 1998; Lyman, 1987). Students have more time to think, become more involved in discussions, thus improving the quality of their answers (Rowe, 1974). Several authors such as Carinih (2020), Fauzi et al. (2021), Hunt et al. (2018), Kaddoura, (2013), Kurjun et al, (2020) consider that this method has a great impact in the classroom, increasing critical thinking, quality of learning and creative writing.

TPS evolves along three phases: (1) Thinking. The teacher forms heterogeneous groups of four students and states a topic to discuss or a problem to solve, giving the students "time to think individually" about the answer; (2) Pairing. The teacher forms two pairs in each group so that students share and discuss their answers in order to achieve a common answer; (3) Share. The pairs share their answers with each other for a few minutes, having to come up with a common answer. Then the teacher calls on one member of each group to SHARE the answer of the group with the rest of the class (Azizah et al., 2020; Silva et al., 2018).

Another of the cooperative learning methods that can be used in promoting critical thinking is the Round Table (Kagan, 1994). This method helps students solve complex conceptual problems as they can discuss them with each other, enabling the development of analysis, synthesis, and evaluation skills (Sari et al., 2021). In this method, the teacher organizes heterogeneous groups of three or four people and distributes a pen and a sheet of paper per group. He presents a task that requires more than one answer and stipulates the time for its completion and a time for each member of the group to write an answer or idea about it. After each person writes, he/she passes the paper and pen on to the next person in the group. The activity ends when the time allotted by the teacher has elapsed. Then, each group shares the final product with the class (Lopes & Silva, 2008; Lopes & Silva, 2009).

Although cooperative learning is one of the methodologies mentioned in the literature for promoting critical thinking at any level of education, most research has been conducted in secondary and higher education (Cottrell, 2017; Slater & Groff, 2017) and the Round Table and Think - Pair - Share methods have been little used (Kaddoura, 2013), even more so when it comes to primary 1 (Chew et al., 2020; Daniel & Gagnon, 2011; Florea & Hurjui, 2015; Huang, 2020). However, several researchers suggest that there is no specific age at which children are apt to think in more complex ways (Silva, 2008) which is the case with critical thinking. This perspective is in line

with the sociocognitive theory of learning and the recommendations of the Delphi Report by Facione (1990). In this report it is stated: "from early childhood, people should be taught, for example, to reason, to seek relevant facts, to consider options, and to understand the opinions of others" (Facione, 1990, p. 27). According to this perspective, the effectiveness of educational interventions to improve critical thinking does not depend on the level of education (Abrami et al., 2015; Bailin et al., 1999; Ennis, 1989; Florea & Hurjui, 2015; Lai, 2011; Massa, 2014; Willingham, 2008).

In Portugal, the development of critical thinking skills is foreseen from preschool to the end of compulsory education, respectively in the Curriculum Guidelines for Pre-School Education (Silva et al., 2017), in the Profile of Students Leaving Compulsory Education (Martins et al., 2017) and in the Essential Learnings documents (Direção Geral da Educação/Ministério da Educação, 2018). In these documents, cooperative learning is one of the strategies that is recommended for early childhood.

Taking in consideration all what has been said previously, the goal of this research is to evaluate the effectiveness of cooperative learning using RoundTable (Kagan, 1994; Suryani et al., 2021) and Think-Pair-Share (Lyman, 1987; Sari et al., 2019) in the development of critical thinking skills of 4th grade students (in Portugal) in the first cycle of basic education, namely observation, interpretation, analysis (inferences) and argumentation when compared to traditional teaching. The aim is to contribute to a necessary knowledge about the use of these cooperative learning techniques at this level of education, still little studied.

Method

Participants

The participants in this study were 41 students from two 4th grade classes of the 1st cycle of basic education in the North of Portugal. The experimental group consisted of 24 students, 10 females and 14 males with average age of 9.3 years ($SD = 0.48$). The control group was composed of 17 students, 5 females and 12 males, aged between 9 and 11 years old with average age of 9.6 ($SD = 0.60$).

Participants were from different schools and belonged to two equivalent classes (in terms of gender and results in the Critical Thinking Test for Basic Education, CTTBE, pretest).

Research design

The study employed a quasi-experimental design with a pretest and posttest (Cohen et al., 2018) using an experimental and a control group, with equivalent

groups in terms of the proportion between males and females ($\chi^2(1, N = 41) = 0.644, p = .422$) and with no significantly different total score in the pretest ($U = 187, p = .652$).

Instruments

As there is no test in Portugal to assess the critical thinking skills of basic school students, a test based on the definition of Critical Thinking in "The Profile of Students at the End of Compulsory Schooling" (Martins et al., 2017) was developed for this study. To construct the test, a set of questions of the type used in the educational progress national tests in 4th grade students in the first cycle was designed and submitted to two experts in critical thinking to assess their relevance and clarity. The experts' evaluation resulted in the Critical Thinking Test for Basic Education (CTTBE) that was applied for testing to a group of students identical to the one that participated in this study. From these procedures resulted a test consisting of 48 items with visual stimuli printed in color (Downey, 2009; Facione, 1990; Gelerstein et al. 2016; Joglar, 2015; Lazo & Smith, 2014) and verbal stimuli, i.e., short texts with authentic situations (Bonk & Smith, 1998; Care et al., 2018; Evans, 2020; Halpern, 1998). The items assess the following skills:

1. Observation (15 items - Restricted response items) - considered a mental activity that is experienced daily through the senses, and it can be stated that it is the most elementary and primitive thinking capacity of the human being, the basis for all other intellectual capacities. It comprises two moments, one concrete and the other abstract (de Sánchez, 2009). It is the starting point for critical thinking (Scriven & Paul, 1987; Thayer-Bacon, 1993). The grading criteria for these questions are organized by performance levels: one point for a correct answer and half a point for an incomplete answer).
2. Interpretation - the ability to understand or express the meaning or significance of data, values, opinions, facts, statements, conclusions, criteria, analogies, drawings, graphs, emotions, experiences, events, intentions, emotions, irony, causes and effects, as well as of conventions (social or business), beliefs, standards, rules, or procedures (Facione, 1990). (14 multiple-choice items - the item is scored only on those answers that unambiguously present the correct option. All other answers are scored with zero points).
3. Analysis - identify conventional and real inferential relationships between statements, questions, concepts, descriptions, or other forms of representation to express beliefs, judgments, experiences, reasons, information, or opinions (Facione, 1990). (18 multiple-choice items - the item is scored only on those responses that unambiguously present the correct option. All other answers are scored with zero points).

4. Argumentation - Ordering and communicating to others the results of one's reasoning; justifying the reasoning and its conclusions in terms of evidence, concepts, methodologies, criteria, and contextual considerations; and presenting the reasoning in a clear, convincing, and persuasive manner (Facione, 1990). (A long-answer item - the classification criteria are organized by levels of performance, and one point is awarded for each argument presented).

The CTTBE reliability is acceptable ($\alpha = 0.72$).

This study followed the ethical requirements of EFPA - European Federation of Psychologists' Associations, as well as of the Portuguese Psychologists Association. All ethical principles were respected, ensuring that all participants knew and accepted the principles of informed consent, voluntary participation and the confidentiality of their responses.

Procedures

Pedagogical context

This study lasted four months during 2019.

Experimental group:

The teacher had over 10 years of experience and attended 20 hours of training on cooperative learning before the beginning of this study, orientated by the authors of this article.

At the beginning of the period the following activities were done in the first class:

1. the students answered the CTTBE test (pretest);
2. the teacher organized heterogeneous groups of four students;
3. different roles were assigned to each member of the group, on a rotating basis and adjusted to the objectives of the activities.

Throughout the following classes 21 cooperative learning activities were implemented using Think-Pair-Share (Cooper, 2018; Lyman, 1987) and RoundTable (Kagan, 1994) with a similar frequency. These activities had the objective to promote the assessed skills by the CTTBE test: observation, interpretation, analysis (inferences) and argumentation in Language Arts, Environment Study and Mathematics (1st Cycle) disciplines (through the observation, reading, writing, discussion and elaboration of Venn diagrams from images, texts, videos on topics like fishing and livestock, pollution, children rights, Portugal revolution of the 25th April, community life of bees and ants).

These learning activities were structured in such a way that the characteristics of cooperative groups were always present, namely, positive interdependence, individual and group responsibility, stimulating interaction (preferably face-to-face), social skills and, occasionally, assessment of the group process. These two methods were used because both allow all group members to freely express their opinions and ideas equally and because they complement each other, enabling the development of oral and written arguments.

At the end of the study, in the last class, the students answered the CTTBE test (posttest).

Control group:

The teacher had over 10 years of experience and did not have any training in cooperative learning

At the beginning of the period, in the first class, the students answered the CTTBE test (pretest).

During the four months duration of the study, the students executed the same learning activities that were performed by the experimental group. The method used to approach the content was traditional teaching, centred on the teacher, focusing on individual work and with some class discussion.

At the end of the study, in the last class, the students answered the CTTBE test (posttest).

The data collection was done in both classes at the same moment by the authors of this paper.

Data processing and analysis

The research data were analyzed using inferential analysis methods. The aim was to examine whether the students' scores of critical thinking skills in the 4th year of schooling in the 1st cycle of Basic Education (namely observation, interpretation, analysis (inferences) and argumentation) of the experimental group with cooperative learning were higher when compared with the group where traditional teaching was used (control group). Before the hypothesis testing was performed, normality and homogeneity tests were done. The comparison of the paired scores' means was performed with a t-test whenever the normality condition was verified. The Wilcoxon signed-rank test was used otherwise. The data were analyzed with the assistance of SPSS version 25.0 for Windows at a significance level of 5%.

The results in Table 1 show that the experimental group had a significant gain in the CTTBE posttest score compared to the pretest score, while the control group had no significant gain. The observed effect size is large ($d = 1.36$). This indicates that the magnitude

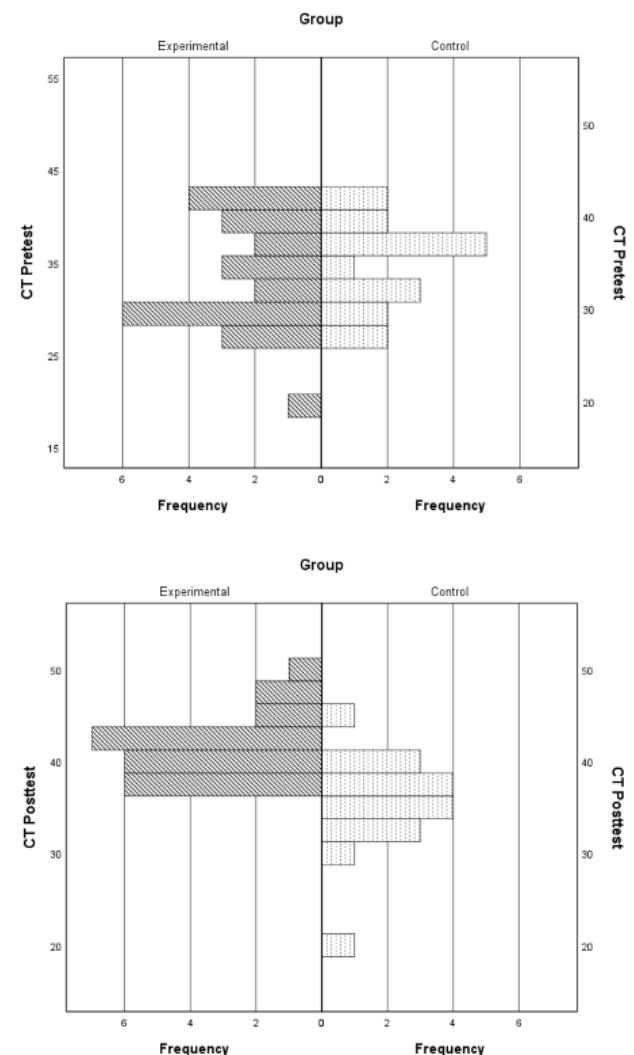
of the difference between the average gains of the experimental and the control group is large.

Table 1.
Analysis of the CTTBE pretest and posttest results for the experimental and control classes

Class	CTTBE test score		Gain in the CTTBE test score		Paired t-test
	M	SD	M	SD	
Experimental (N = 24)	Pretest	33.81	6.12		$t(23) = -7.30$ $p < .001$
	Posttest	41.42	3.34	7.60	
Control (N = 17)	Pretest	34.71	4.92		$t(16) = -0.57$ $p = .577$
	Posttest	35.32	5.21	0.62	

Figure 1 shows the distribution of the total score in the pre and posttest for the two classes. The decrease in the amplitude of the results in the CTTBE posttest for the experimental group means that the intervention led to smaller disparities between the students of that class. There is a general positive evolution of all the students of the experimental group, contrary to what happens in the control group.

Figure 1.
Results in the CTTBE test for the Experimental and the Control group



As for the skills analyzed with the CTTBE test, the experimental group had a significant increase in the score (from pre to posttest) in all skills and the control group only had a significant increase in Analysis (Table 2).

Comparing the gains obtained by the two groups in each skill, the standardized effect size, $r = Z/\sqrt{n}$, was computed. This one revealed to be large for Observation ($r = .55$) and Interpretation ($r = .63$), small for Analysis ($r = .13$), and medium for Argumentation ($r = .31$). That shows that the magnitude of the differences between the scores of the experimental group and the control group are large for skills Observation and Interpretation.

Discussion of findings

The objective of this study was to evaluate the effectiveness of cooperative learning using the RoundTable (RT) and Think-Pair-Share (TPS) methods in the development of critical thinking skills (namely observation, interpretation, analysis (inferences) and argumentation) of 4th grade students of Basic Education, when compared to traditional teaching. Students in the experimental class had significant average gains in all critical thinking skills (global gain), while the control class did not. The students in the latter regressed in their observation and interpretation skills and improved in their ability to argue and analyze, with the average differences being statistically significant only in analysis.

The comparison of the results of the two classes also shows that with the use of cooperative learning, the individual differences in the total score of critical thinking skills decreased. In the control class, with the traditional pedagogy, the individual differences

in the total score increased from pre to posttest. The decrease in the differences in the test scores in the experimental group is essentially related to the fact that the students with lower performance at the start obtained greater gains.

These results show that cooperative learning is an efficient pedagogic methodology for the promotion of Critical Thinking skills. This supports the well-known literature on cooperative learning more studied at the secondary and superior educational levels (Johnson et al. 2008; Johnson & Johnson, 2016; Patesan et al., 2016). The two cooperative learning techniques used in this study, RoundTable and Think-Pair-Share, have also shown their efficacy at those levels (Carinih, 2020; Choi & Mantik, 2017; Fauzi et al., 2021; Hunt et al., 2018; Kaddoura, 2013; Sari et al., 2021; Suryani, 2021).

The present study adds on to the existing literature focusing at the elementary educational level (level at which the literature is scarce) confirming that, at this level, it is possible to develop critical thinking skills (Floreá & Hurjui, 2015; Quesnel, 2015; Willingham, 2008).

This study also reinforces the previous literature on the effect of cooperative learning that shows that although both groups of students, low-achievers and high-achievers progress (Kent et al., 2015; Sangeeta & Sunita, 2019; Slavin, 1995), the first ones benefits more (Johnson et al., 2008; Reinhard, 2021) from cooperative learning, probably due to the fact that they have the opportunity to get familiarized with the learning strategies used by the second ones, through their interaction.

In a teacher-centered classroom, some of the low-achieving students feel shy to ask questions and there are fewer opportunities to interact with

Table 2.
Statistics of the scores in the CTTBE test in experimental group

Skill	Class		M	SD	Wilcoxon signed-rank test	
Observation	Experimental (N = 24)	Pretest	9.31	2.20	Z = -3.59, p < .001	
		Posttest	11.71	1.64		
	Control (N = 17)	Pretest	9.18	1.51		Z = -0.874, p = .382
		Posttest	8.85	1.63		
Interpretation	Experimental (N = 24)	Pretest	11.25	2.57	Z = -3.42, p < .001	
		Posttest	13.42	0.72		
	Control (N = 17)	Pretest	13.00	1.17		Z = -1.31, p = .190
		Posttest	12.47	2.32		
Analysis	Experimental (N = 24)	Pretest	10.58	1.86	Z = -3.22, p = .001	
		Posttest	12.63	1.84		
	Control (N = 17)	Pretest	10.0	2.06		Z = -2.26, p = .024
		Posttest	11.29	1.76		
Argumentation	Experimental (N = 24)	Pretest	2.67	1.90	Z = -2.97, p = .003	
		Posttest	3.67	1.37		
	Control (N = 17)	Pretest	2.53	1.62		Z = -0.371, p = .711
		Posttest	2.71	1.72		

their colleagues. In turn, in a cooperative learning environment, more student-centered, low-achievers feel freer and more motivated to share their doubts and questions with their peers (Sangeeta & Sunita, 2019; Slavin, 1995). Moreover, they learn how to overcome their deficiencies in strategic and metacognitive knowledge (Hoek et al., 1999; Majoka et al., 2007). According to Ledlow (2001), TPS is a great method to actively involve students in the learning process, mainly in the Pair stage when students come together to discuss the results of their previous thinking (Surayya et al., 2014) having students involved focusing on their answers and discussions with their peers (Robertson, 2006). Our results confirm those of Alfian (2018) who concluded that students' critical thinking skills improve when the TPS methodology is used.

The Round-Table method allows students to review the work written by their peers, which determines that they develop a conceptual understanding of a topic, the ability to evaluate information and to consider other points of view (Parmawati et al., 2020).

In synthesis, our study contributes to the literature on the effectiveness of cooperative learning to develop critical thinking skills, adding evidence for the Basic Education (first cycle - grades one to four), not much studied until now. It reinforces, though, the controversial idea that critical thinking can be developed at early stages of education with young children (Slavin, 2014; Sills et al., 2016).

Limitations for this study and future investigation

It is important to stress that there is no critical thinking test validated for the level of education here in appreciation. That limitation was somewhat overcome with the creation of a test which allowed to evaluate pre and post treatment. However, for the generalization of this study, it would be important to validate this test at this level of education. The reduced number of students in both groups can also be seen as a limitation.

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