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The effect of implementing a critical thinking intervention program on English language learners' critical thinking, reading comprehension, and classroom climate

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Abstract

Entering the age of globalization and multi-cultures, the education system has become more accountable to provide a positive and productive learning atmosphere in which both life skills and academic skills are taught and trained. Following this welcoming trend, the present study sought to integrate a proposed critical thinking-based intervention program (3Es) on the ground of Bloom's original and revised Taxonomy (1956, 2001) into a BA English reading course. This study examined the treatment's effect on learners' critical thinking, attitudes toward L2 classroom climate, and reading comprehension in an English as a foreign language context of Iran. According to the placement test results, excluding the upper-intermediate ones left a sample of 40 (29 females and 11 males) intermediate participants being assigned to two groups: control and experimental. While the former received conventional instruction, the latter was exposed to the critical thinking program presented in three stages: exposure, exploration, and evaluation. The data were derived from Honey's critical thinking questionnaire (2004), the L2-contextualized adapted version of WIHIC (What Is Happening In The Class) designed by Fraser *et al.* (1986), and the British Council reading comprehension tests. After analyzing the data, the results demonstrated positive changes in the experimental group participants' critical thinking, reading comprehension, and learners' attitudes toward classroom climate after implementing the critical thinking intervention program. Our findings contribute to firstly EFL practitioners and curriculum designers, as the main authorities in revising and developing curricula and educational facilities to include the skill of critical thinking as one of the major contributors to the positive atmosphere of the class, and next to the teachers to become cognizant of the influential role of critical thinking in students' attitudes toward the classroom and their academic development.

Keywords: Classroom climate, Critical thinking, Critical thinking intervention program, English as a foreign language, Reading comprehension

Introduction

Globalization and technological advances have resulted in significant changes in the scope, concept, and objectives of a socially responsible education system. Today, there is almost a consensus that to prepare students to be sufficiently constructive in their personal and social life, education should change its focus from merely content and academic development to individual and non-academic development as well (Oliveri & Markle, 2017). Critical thinking is one of the fundamental 21st-century skills that should be incorporated into pedagogical environments (Ennis, 2018). The skill has also attracted the attention of businesses and skilled labor recruitment agencies. According to the National Association of Colleges and Employers, critical thinking is rated as the most demanded competency when hiring employees (NACE, 2017). Moreover, the World Economic Forum identified ten core skills for the business world by 2025, and CT topped the list (World Economic Forum, 2020). Being equipped with CT skills and dispositions, individuals become reflective and conscious when encountering problems and daily challenges (McPeck, 2016). Moreover, they acquire the ability to make efficient decisions and distinguish between facts and opinions (Ennis, 1985) which leads them to become more autonomous and active in the process of learning and achieving their goals (D'Alessio et al., 2019; Utriainen et al., 2016). Supreme efforts, therefore, have been made to purposefully incorporate CT into the realm of education in general and language teaching and English as a foreign or second language (EFL/ESL) in particular (Heidari, 2020; Kamgara & Jadidi, 2016; Larsson, 2017; Liu & Stapleton, 2018; Romero & Bobkina, 2021; Soufi & See, 2019; Zare & Biria, 2018). There is, however, almost no consensus on how CT should be taught. Several approaches to teaching CT were described by Ennis in 1991, including general, immersion, infusion, and mixed approaches.

In a general approach, CT skills and dispositions are taught separately and explicitly in terms of how they work and how they can be put into practice (Alan Bensley & Spero, 2014). Another CT instructional approach is the infusion approach, which is similar to the general approach in the explicit teaching of CT, yet the skills and dispositions are infused into the subject matter (McLaughlin & McGill, 2017). As a third instructional CT approach, Ennis (1991) proposed the immersion approach in which CT is immersed into the content of the subject matter in a way that its skills and dispositions are developed implicitly. It is supposed that CT can be cultivated indirectly through a host of activities, debates, and discussions for instance (Gann, 2013). Mixed approaches combine either infusion or immersion with the general approach to teaching CT (Orhan & Çeviker Ay, 2022).

On the one hand, each CT instructional approach has its own advantages. As an example, some believe that the integration of CT into a subject matter can increase learners' motivation and interest, which enhances the likelihood of success and a better outcome (Daniel & Auriac, 2011; Willingham, 2008). On the other hand, as exploring the literature review suggests despite a vast array of studies on the effectiveness of these approaches, the results are mixed, and none of these approaches are superior (Cáceres et al., 2020; Kennedy et al., 1991; Larsson, 2017). Introducing the 3Es, Bakhtiari Moghadam et al. (2021) derived benefits from the immersion approach.

Another significant point about CT that needs to be highlighted is that CT is composed of both cognitive and affective components (Kennedy et al., 1991). Critical

thinkers need to cultivate not only a set of skills but also certain dispositions. To think critically, one must not only be able to acquire and apply skills such as inference and interpretation, but also possess dispositions and inclinations to put those skills into practice, such as an open mind or willingness to seek information (Ennis, 2018). Being reluctant and not having inclinations toward CT, one may not apply CT skills. Introducing and implementing the 3Es, Bakhtiari Moghadam et al. (2021) focused primarily on CT skills. However, dispositions were implicitly encouraged at all stages. This was done by encouraging learners to listen to each other's viewpoints with respect or helping them to determine the trustworthiness of sources of information for instance.

However, there still is a discrepancy between EFL countries' mere linguistic focus and a surge in worldwide demand for integrating non-linguistic aspects of language learning like CT which is training students in a way to become not only proficient language learners but also effective communicators and problem solvers in today's globalized world (Akbarzade, 2014; Memari, 2021). In Iran's traditional context with a particular language learning policy, most teachers in educational settings still emphasize language learning as merely the application of grammatical rules in written practice and being orally fluent in communication, without being aware of the importance of personal development, mainly CT, to education as the focus of learning languages throughout the world (Kaviani & Mashhadi Heidar, 2019).

On the other hand, inspired by revolutionized changes in the objectives of the education system to welcome both academic and personal development, the so-called classroom climate as a flourishing field of research has recently captured the attention to raise qualities and standards of the learning environment and learners' achievements (Aldridge & Galos, 2018; Cimpian et al., 2021; Dorman & Fraser, 2009; Nelson-Harwood, 2011). It is ineffective to bring any fundamental far-reaching changes in the curriculum, instructional methods, strategies, or characteristic features of both teachers and students without regarding the viable role of the learning climate. Delineating the impact, Barr (2016) noted that the climate of the learning setting could function as a trigger or motivator to facilitate the teaching and learning process, leading to better pedagogical and educational outcomes. Therefore, the stream of most related studies has endeavored and supports the idea of creating a positive learning atmosphere in which the students cooperate and hold positive attitudes toward the classroom and learning process. (Alonso-Tapia & Nieto, 2019; Rahimi & Ebrahimi, 2011; Wang et al., 2020). However, due to the lecture-based and teacher-centered nature of instructional methods in the EFL context of Iran, students have been conditioned to be passive recipients of the information who rarely hold a positive attitude toward the learning environment.

Considering reading comprehension as one of the essential language skills, it necessitates the reader to incorporate the thinking process to decode not only the literal meaning of the words in the passage but also the implicit and hidden meanings beyond the words. That is, to have a thorough comprehension of a text, one needs to gradually construct meaning by identifying and analyzing the primary information, evaluating the trustworthiness of information sources, making interconnections with her/his background knowledge, and synthesizing and reflecting on the last data (Li et al., 2016; Yu-hui et al., 2010). Hence, various levels of thought are simultaneously involved as the reading process begins. Therefore, reading comprehension has been regarded as an

appropriate and influential platform to cultivate and promote learners' critical thinking (Heidari, 2020). However, in Iran, it is still believed that reading is a passive skill that does not necessitate the readers to be active and interactive compared to speaking or listening skills. On the foundation of this view, students are regarded as passive receivers of knowledge who usually accept the teacher's words and play the role of 'mute outsiders' to the reading process.

Reviewing the literature, the researchers found that the way critical thinkers see themselves, events, and the world is also changing (Bakhtiari Moghadam et al., 2021), making them more analytical, rational, and logical as they encounter life challenges. On the other hand, it has been widely confirmed that there is a positive correlation between CT and some other desired abilities like language skills. Therefore, the researchers of the current study hypothesized that CT could contribute to a more positive classroom climate and improved comprehension among EFL learners. All things considered, the current study sought to investigate whether utilizing the proposed CT-intervention program (Bakhtiari Moghadam et al., 2021), namely 3Es, is effective in the improvement of EFL learners' critical thinking, reading comprehension, and attitudes toward the classroom climate. Accordingly, the following research questions were posed and investigated respectively.

Is the implementation of the CT-intervention program, 3Es, statistically effective in empowering learners with critical thinking?

Is the implementation of the CT-intervention program, 3Es, statistically effective in improving learners' attitudes toward classroom climate?

Is the implementation of the CT-intervention program, 3Es, statistically effective in developing learners' reading comprehension?

Review of literature

Bloom (1956) along with a team of educational psychologists, worked on the cognitive aspect of the educational objectives and proposed a framework in which three lower levels of thinking, namely knowledge, comprehension, and application, and three higher levels of thinking, including analysis, synthesis, and evaluation, were identified to guide instructors on how critical thinking as the outcome of the stages can be achieved. In his hierarchical pyramid-shaped taxonomy, mastery of each level is a prerequisite for going to the next level (Bloom, 1956).

In 2001, the taxonomy was revised and updated by Anderson, one of Bloom's students. This was done along with a group of cognitive psychologists, curriculum theorists and instructional researchers, and testing and assessment specialists. Some significant changes in terms of terminology and structure have been made in the revised format of the taxonomy to highlight the action-based nature of cognitive levels. As a result, the steps were renamed remembering, understanding, applying, analyzing, evaluating, and creating (Fig. 1) which emphasizes a more dynamic model for classifying the intellectual processes being used by (Anderson et al., 2001; Kusumoto, 2018).

In putting endeavor to employ the taxonomy of Bloom, many researchers of different disciplines have carried out studies and found a host of influential CT techniques



Fig. 1 Bloom's original and revised taxonomy

and strategies which make the taxonomy practical and advance critical thinking throughout six levels of cognitive progression (Athanasios & McNett, 2003; Duron et al., 2006; Pappas et al., 2013; Sharunova et al., 2018; Tuma & Nassar, 2021; Živkovic, 2016). What most of these scholars have a consensus on it is that lecture-based activities cannot promote CT. In fact, there should be an environment in which questioning, debating, seeking information, evaluating, problem-solving, and collaborative tasks are appreciated and implemented while students are simultaneously guided and scaffolded through a six-step Bloom's Taxonomy framework.

Following this trend, making Bloom's Taxonomy content-related and practical, Bakhtiari Moghadam et al. (2021) did a meta-analysis of the related literature, including the examination of diverse proposed CT models and frameworks using Bloom's Taxonomy, as well as the empirical studies on the effective techniques and learning environment supporting and facilitating CT skills and dispositions in practice. They found that rebuilding and reshaping the learning environment is one of the most important and influential aspects of CT instruction (Duron et al., 2006; Rolón, 2014). Thus, they sought to provide students with opportunities to participate in dialogues and controversial debates and gather information from trustworthy sources so that the barriers to their thought and language development were removed (Bag & Gürsoy, 2021; Lin et al., 2016; Paul & Elder, 2014; Utriainen, 2016; Walker, 2003). This was accomplished by integrating CT skills into the content of the reading classroom. It fostered an atmosphere of learning where learners were free to express and exchange their opinions on both academic and personal topics (Chamot, 1995; Schuitema et al., 2017). In addition, active and collaborative learning was emphasized, along with a range of information-based, experience-based, and reflective-based activities, as well as providing learners with opportunities to engage in meaningful and critical negotiation and communication (Bean, 2011; Kusumoto, 2018; Lin et al., 2016; O'Flaherty & Costabile, 2020; Walker, 2003).

The output of their analyses was a contextualized CT-intervention program built on Bloom's CT Taxonomy framework, which guided students to think critically by actively and sequentially participating in and practicing the tasks included in all three stages of exposure, exploration, and evaluation as they constructed their reading comprehension in an L2 classroom. Employing this framework in the present study, we sought to create a community of inquiry where students were encouraged to

freely express their feelings and points of view and were engaged in critical thinking, searched for evidence, and reflected on their understanding through their questioning, supporting evidence, and reflective arguments.

Methodology

Participants

To answer the research questions, the present study included fifty-three BA students majoring in English language teaching (ELT), including 36 females and 17 males from two intact classes. They enrolled in a required BA English reading course at the foreign languages department of the Islamic Azad University of Kerman, Iran, during the academic year 2021–2022. Randomly, one class was selected as the control group (CG), and the other as the experimental group (EG). To ensure that the participants of the study were at almost the same level of English proficiency, the researchers applied the Longman Placement Test before starting the project. According to the placement test results, 75.5% of the participants were intermediate English language learners, and 24.5% were upper-intermediate English language learners. We excluded the upper-intermediate participants from the final data analysis and deliberately omitted three participants from the result to have the same number of participants in each group. A total of 20 students were assigned to each group (13 females and 7 males in EG, 16 females and 4 males in CG) who had never received critical-based learning instruction before. The participants in this study ($N=40$) ranged in age from 23 to 34 in EG and CG groups (EG: $M=28.80$, $SD=2.89$, CG: $M=27.75$, $SD=3.32$). Ethical approval for this study was obtained from the university administrators. It was explained to the students that they could participate in the course even if they did not agree to be part of the research. During the project, students' participation was voluntary, and they received no remuneration (Table 1).

Instruments

To capture and collect the required data before and after the project, the researcher utilized a quantitative research method by applying two questionnaires and a test. A description of each instrument is presented here.

Critical thinking questionnaire

To investigate the participants' primary and final levels of critical thinking, the researchers administered Honey's (2004) critical thinking questionnaire at the beginning and end of the treatment implementation. Since the participants majored in English language

Table 1 Gender distribution of participants

Group		Frequency	Percent
Control	Female	16	80
	Male	4	20
	Total	20	100
Experimental	Female	13	65
	Male	7	35
	Total	20	100

teaching, the original version of this questionnaire was used. The questionnaire consists of 30 items which are based on a five-point Likert scale, ranging from never to always. To give meaning to the participants' responses and calculate the test results' numerical value, every option was given a value as follows: never = 1, rarely = 2, sometimes = 3, often = 4, and always = 5. The questionnaire was validated by Honey (2004) concerning content and construct validity (Cited in Zare et al., 2021), and its reliability was reported as 0.81. Additionally, Cronbach's alpha was used to determine the reliability of the questionnaire, which was 0.85 for the pretest and 0.89 for the posttest.

Classroom climate questionnaire

To assess the impact of 3Es as a CT-intervention program on classroom climate, the researcher used the WIHIC questionnaire (What Is Happening in This Class) designed by Fraser et al. (1986). WIHIC measures seven factors, including Student cohesiveness, Teacher Support, Involvement, Investigation, Task Orientation, Cooperation, and Equity, based on a 5-point Likert scale ranging from 1 "strongly disagree" to 5 "strongly agree". In this study, the questionnaire was adapted to harmonize with the current L2 context. The validity and reliability of the WIHIC questionnaire have been widely reported in studies employing the instrument across diverse subject areas in different countries (Aldridge & Fraser, 2000; Margianti et al., 2001; Riah & Fraser, 1998; Zandvliet & Fraser, 1998). In the present study, the internal reliability of the questionnaire was estimated by Cronbach's alpha as 0.96 (pretest) and 0.90 (posttest), which shows high reliability.

Reading comprehension tests

To assess the participants' reading comprehension, three reading comprehension tests were extracted from the British Council Website, intermediate level (<https://www.Britishcouncil.org/>) and were used in this study. Each test consisted of 18 items that showed how much the students comprehended the readings. The reading passages were followed by multiple-choice, true/false, and matching questions. The focus of all tasks was on checking students' understanding of the text. One hour was given to the participants to answer the reading questions. Since the passages were chosen from the British Council site, they were valid in terms of difficulty, graded vocabulary items, grammatical structures, content, and face (see the link to the test: Robot teachers | Learn English (britishcouncil.org)). The reliability of the reading test was determined using the test-retest method. To determine test-retest reliability, 15 university students similar to the target population were tested. After one month, the same test was administered to the same participant to gauge the stability of the results. Pearson's correlation coefficient was used to assess the test reliability coefficient value. The correlation coefficients regarding the test tasks were significant, as shown in Table 2, which shows that the test was consistent and reliable.

Table 2 Test-retest reliability coefficient

Test-retest	Multiple-choice	Matching	True/False	Overall
Reliability Coefficient	0.91	0.85	0.90	0.96

Procedure

Firstly, the participants were given a consent form. They could withdraw from the project at any phase of the study. Only students who completed all project stages were included in the final data collection and analysis. The participants of both groups (CG & EG) enrolled in a semester course on English reading comprehension for EFL learners for a 25-session period which lasted about four months. The course met two days per week for 90 minutes. The instructor, who was also one of the researchers in the study, was the same for both groups. And, to ensure homogeneity between the two groups, both classrooms used the same instructional materials. For four months, only the experimental group was exposed to the treatment (CT intervention program), while the control group did not receive any CT instruction and instead followed the reading book directions delivered by the same lecturer. For the control group, firstly, the teacher presented the text, asked some pre-reading questions, and read the passage while students were checking the words' pronunciation and meaning. Then, the teacher allowed the students to reread the text to fully comprehend it. After that, the teacher explained the content with the help of volunteered students. Then, the students were asked to work through the after-reading questions, answer them, and discuss them in groups. During the following sessions, the rest of the book activities, including working on questions with the aim of vocabulary building and language focus, were covered. For the experimental group, Bloom's Taxonomy stages were integrated into the content of the book. That is, in presenting the reading texts, the instructor followed a host of practical techniques aimed at cultivating lower and higher levels of thinking. The explanations of the CT-intervention program's stages are provided as follows.

Stage one: exposure (simple reflection)

To begin with, the teacher presented the text and asked the students if they had any ideas about the title and pictures of the text. Then, the text was read, and the students were asked to check the pronunciation of the new words. After that, the learners were exposed to different texts on the same topic to see one topic from various perspectives. Being exposed to different texts around the same issue raises the students' awareness by expanding their perspective on the issue and giving them a chance to see one issue from different aspects. This can affect the way they think about the world, and the way they experience, feel, or perceive the world around them. During this period, the learners gained a deeper understanding of the world around them and acquired knowledge through exposure to various aspects of a topic. Since L1 linguistic properties hinder learning novel patterns (Kuhl et al., 2005), more exposure to L2 can expand their horizons. Then, the teacher asked the learners to reflect (simple reflections) on the exposed contents by stating what they had read and what they perceived. It was a starting point to help the participants express their thoughts and feelings openly and freely.

Stage two: exploration (analytic reflection)

During this phase, students were asked to answer after-reading questions and share their answers. Then, the participants were asked to explore the reading passages from any possible viewpoint, trying to break down the text information into smaller parts.

This was achieved by having learners apply the WH-Questions (who, what, when, where, why) to the text issue to consider details and understand the problem more deeply. The instructor guided the students to analytically investigate the text, pose effective questions, and cooperatively answer their own and others' questions. From this phase students developed a sense of curiosity about the text, making comparisons, and thinking about it to provide deep and analytical responses to the discussion.

Stage three: evaluation (critical reflection)

In stage three, the learners were asked to engage in an evaluative process. Here students were expected to assess information and conclude its value or the bias behind it. They could pull in knowledge from multiple subjects and synthesize it before concluding. Here the focus was on objectively and critically analyzing in-depth aspects of the experience and taking inside and outside knowledge into account while evaluating information. In the third phase, judgments, or simple assertions of like or dislike, agree or disagree were not allowed. They should provide reasons for whatever they wanted to say. Moreover, students were tasked with developing the ability to evaluate the reliability of their own and others' assertions or other sources of information, determine whether they are facts or opinions, and provide reasons for their claims. In the process, they were taught how to evaluate the value of an assertion, issue, or event based on its plausible explanation, as well as how to realize that behind any piece of information, there is probably a reason; if not, it is a mere opinion influenced by ignorance, stereotypes, and bias. This phase assisted students in critically seeing and being self-monitored of thoughts and attitudes and assessing received information to decide what is fact and what is opinion. Critical seeing is a higher form of seeing that involves the critical application of knowledge and demands a critical interpretation of what we see. This phase includes Bloom's two last levels of synthesis and evaluation.

Results

Table 3 presents the descriptive statistics of research variables in control and experimental groups in pretest and posttest.

As Table 4 shows, all research variables had a normal distribution. Therefore, parametric tests were used.

Regarding the first null hypothesis, H01, the implementation of the CT-intervention program, 3Es, is not statistically effective in empowering learners with critical

Table 3 Descriptive statistic of research variables

Time	Variable	Control		Experimental	
		Mean	Std. Deviation	Mean	Std. deviation
Pretest	Reading Comprehension	10.00	1.38	10.15	1.31
	Critical Thinking	60.50	6.13	58.25	6.69
	Classroom Climate	31.38	2.39	30.50	3.41
Posttest	Reading Comprehension	12.85	1.18	17.25	1.65
	Critical Thinking	67.00	5.87	118.75	7.67
	Classroom Climate	31.42	2.34	53.71	3.04

Table 4 Normality of research variables' distribution

Group	Variable	Time	Kolmogorov–Smirnov Z	n	p-value
Control	Critical Thinking	Pretest	0.599	20	0.9
		Posttest	0.45	20	0.99
	Classroom Climate	Pretest	0.13	20	0.2
		Posttest	0.14	20	0.2
Experimental	Critical Thinking	Pretest	0.89	20	0.4
		Posttest	0.897	20	0.4
	Classroom Climate	Pretest	0.56	20	0.9
		Posttest	0.46	20	0.98
Experimental	Classroom Climate	Pretest	0.15	20	0.17
		Posttest	0.12	20	0.2
	Reading Comprehension	Pretest	0.88	20	0.4
		Posttest	0.849	20	0.5

Table 5 Test of homogeneity of variances (critical thinking)

F	df1	df2	p-value
1.03	1	38	0.020

Table 6 Regression slope homogeneity test (critical thinking)

Source	Sum of Squares	df	Mean square	F	p-value
Group	2002.84	1	2002.84	72.35	0.2
Pretest	30.55	1	30.55	1.1	0.3
Pretest × Group	765.48	1	765.48	27.65	0.000
Error	996.55	36	27.68	–	–

Table 7 Independent sample T-test of critical thinking

Group	N	Mean	St. deviation	T-Test	df	p-value
Control	20	6.5	2.95	–19.29	21.14	0.000
Experimental	20	61.5	12.4			

thinking, since the assumption of homogeneity of regression slopes and homogeneity of variances were violated, ANCOVA was not appropriate to analyze the data ($F(1,36) = 27.65, p < 0.01$) (Tables 5 and 6).

Therefore, the pre-test scores of this variable (CT) were removed, and then the post-test scores of the two groups (EG & CG) were compared using an independent sample t-test. As Table 7 shows, the result of the independent sample T-test analysis showed a significant difference in the mean scores for critical thinking in the post-test of the control group and the post-test of the experimental group ($p < 0.01$). Comparing EG participants to CG participants, CT improved in EG. Accordingly, the null hypothesis

Table 8 Test of homogeneity of variances (classroom climate)

F	df1	df2	p-value
49.37	1	46	0.072

Table 9 Test of homogeneity of regression slopes (classroom climate)

Source	Sum of Squares	df	Mean Square	F	p-value
Group	146.21	1	146.21	338.43	0.000
Pretest	294.64	1	294.64	682.01	0.000
Pretest × Group	1.31	1	1.31	3.03	0.090
Error	19.01	44	0.43	–	–

Table 10 The result of covariance analysis of classroom climate

Source	Sum of squares	df	Mean Square	F	p-value	partial η^2
Pretest	318.48	1	318.48	705.4	0.000	
Group	2480.32	1	2480.32	5493.73	0.000	0.99
Error	20.32	45	0.45	–	–	
Corrected Total	6301.81	47	–	–	–	

Table 11 Estimated marginal means of classroom climate

Group	Estimated marginal Mean	St. Error
Control	59.01	0.24
Experimental	26.12	0.24

is rejected. The effect size for critical thinking was estimated at 7.17 ($ES = 7.17$) and $r = 0.96$, which is statistically significant.

To test the second null hypothesis, H_{02} , the implementation of the CT-intervention program, 3Es, is not statistically effective in improving learners' attitudes toward classroom climate, Levene's test and normality checks were performed, and other assumptions, including homogeneity of variance, the linear relationship between the dependent variable and covariates, and homogeneity of regression slopes were met (Tables 8 and 9). Therefore, the ANCOVA test was run for the classroom climate variable.

According to Table 10, there is a meaningful difference between the experimental and control groups' mean scores regarding the classroom climate post-test. Therefore, the CT-intervention program, 3Es, had a significant effect on changing participants' attitudes toward classroom climate ($p < 0.01$). The estimated partial Eta Squared is (partial $\eta^2 = 0.99$), which shows a significant effect. The implementation of the CT-intervention program, 3Es, led to an increase of 99% in attitudes toward classroom climate (Table 10). Therefore, the null hypothesis is rejected.

Compared to CG, attitudes toward classroom climate significantly improved in EG (Table 11).

Table 12 Test of homogeneity of variances (reading comprehension)

F	df1	df2	p-value
1.43	1	38	0.2

Table 13 Test of homogeneity of regression slopes (Reading Comprehension)

Source	Sum of Squares	df	Mean Square	F	p-value
Group	2.62	1	2.62	1.31	0.3
Pretest	6.01	1	6.01	2.99	0.09
Pretest × Group	0.02	1	0.02	0.01	0.9
Error	72.29	36	2.01	–	–

Table 14 The result of covariance analysis (reading comprehension)

Source	Sum of Squares	df	Mean Square	F	p-value	partial η^2
Pretest	5.98	1	5.98	3.06	0.09	
Group	189.1	1	189.1	96.75	0.000	0.72
Error	72.32	37	1.96	–	–	
Corrected Total	271.9	39	–	–	–	

Table 15 Estimated marginal means (reading comprehension)

Group	Estimated Marginal Mean	St. Error
Control	12.87	0.31
Experimental	17.23	0.31

To examine the third null hypothesis, H03, the implementation of the CT-intervention program, 3Es, is not statistically effective in developing learners' reading comprehension, Levene's test and normality checks were performed, and the assumptions were met. Homogeneity of variance, the linear relationship between the dependent variable and covariates, and homogeneity of regression slopes were met (Tables 12 and 13). Therefore, the ANCOVA test was run for the reading comprehension variable.

Table 14 shows that there is a significant difference between the mean scores of the experimental group and the control group regarding reading comprehension. Therefore, the CT-intervention program had a significant effect on improving the participants' reading comprehension ($p < 0.01$). The estimated partial Eta Squared is (partial $\eta^2 = 0.72$) which shows a large effect. Therefore, the null hypothesis is rejected.

According to the estimated marginal means, the experimental group performed better in reading comprehension compared to the control group (Table 15).

As Table 16 shows, the result of Independent sample t-test analysis did not show a significant difference in the mean scores for Reading Comprehension in the pre-test of Control Group ($M = 10.00$, $SD = 1.38$), and pre-test of Experimental group ($M = 10.15$, $SD = 1.31$), $t = -0.35$, $df = 38$, $p > 0.05$; the result confirmed there was not a significant difference in the mean scores for Critical Thinking in the pre-test of Control Group

Table 16 Independent sample T-test of research variables (pre-test)

Variable	Group	N	Mean	St. deviation	T-Test	df	p-value
Reading Comprehension	Control	20	10.00	1.38	-0.35	38	0.710
	Experimental	20	10.15	1.31			
Critical Thinking	Control	20	60.50	6.13	1.6	38	0.101
	Experimental	20	58.25	6.69			
Classroom Climate	Control	20	31.38	2.39	2.96	38	0.065
	Experimental	20	30.50	3.41			

Table 17 Independent sample T-test of research variables (post-test)

Variable	Group	N	Mean	St. deviation	T-Test	df	p-value
Reading Comprehension	Control	20	12.85	1.18	-9.69	38	0.000
	Experimental	20	17.25	1.65			
Critical Thinking	Control	20	67.00	5.87	-23.97	38	0.000
	Experimental	20	118.75	7.67			
Classroom Climate	Control	20	31.42	2.34	-28.45	38	0.000
	Experimental	20	53.71	3.04			

($M=60.5$, $SD=6.13$), and pre-test of Experimental group ($M=58.25$, $SD=6.69$) $t=1.6$, $df=38$, $p>0.05$ and the result confirmed there was not a significant difference in the mean scores for Classroom Climate in the pre-test of Control Group ($M=31.38$, $SD=2.39$), and pre-test of Experimental group ($M=30.50$, $SD=3.41$) $t=2.96$, $df=38$, $p>0.05$.

As Table 17 shows, the result of Independent sample t-test analysis shows a significant difference in the mean scores for Reading Comprehension in the post-test of Control Group ($M=12.85$, $SD=1.18$), and post-test of Experimental group ($M=17.25$, $SD=1.65$), $t=-9.69$, $df=38$, $p<0.01$; the result confirmed there was a significant difference in the mean scores for Critical Thinking in the post-test of Control Group ($M=67.00$, $SD=5.87$), and post-test of Experimental group ($M=118.75$, $SD=7.67$) $t=-23.97$, $df=38$, $p<0.01$ and the result confirmed there was a significant difference in the mean scores for Classroom Climate in the post-test of Control Group ($M=31.42$, $SD=2.34$), and post-test of Experimental group ($M=53.71$, $SD=3.04$) $t=-28.45$, $df=38$, $p<0.01$. the effect size of Reading Comprehension was $ES=3.06$ and $r=0.84$; effect size of Critical Thinking was $ES=7.57$ and $r=0.96$ and effect size of Classroom Climate was $ES=8.21$ and $r=0.97$. Therefore, the magnitude of the effect size for all research variables was significant.

Discussion

Using an experimental research design with two groups of English language learners in reading classrooms, significant improvements in critical thinking and reading comprehension were found for the experimental group but not for the control group. Moreover, the results showed that implementing the CT-intervention program, 3Es, in the experimental group made the climate of the classroom more positive in contrast to the control group. The statistical analysis answered the research questions as follows:

Regarding the first research question, Is the implementation of the CT-intervention program, 3Es, statistically effective in empowering learners with critical thinking, the statistical analysis revealed that the EG group outperformed the CG in critical thinking. The result of the current research is aligned with a significant number of studies in different educational disciplines that have used Bloom's Taxonomy to design and validate CT models and frameworks (Duron et al., 2006; Tuma & Nassar, 2021; Živkovic, 2016). Furthermore, the findings are in line with studies that support the effectiveness of embedding CT skills and dispositions in educational systems, which help students achieve critical thinking and learning objectives (e.g., Din, 2020; Forawi, 2016; Moosavi, 2020; Romero & Bobkina, 2021; Utriainen et al., 2016; Veliz & Veliz, 2018). Moreover, the present study emphasizes the crucial role instructional techniques play in CT promotion. To facilitate CT skills and dispositions, active and cooperative learning principles are valued and implemented. Furthermore, the results indicated that passive academic approaches, such as lectures in which knowledge is delivered unilaterally from instructors to students, may limit the development of CT skills; rather, students need to be given the opportunity to engage in a variety of influential techniques and strategies, such as questioning, debating, reflecting, supporting evidence, and solving problems, so that they can shift from passive to active and critical thinkers.

In response to the second research question, Is the CT-intervention program, 3Es, statistically effective in improving learners' attitudes toward classroom climate, the results indicated that implementing the 3Es framework impacted classroom climate and encouraged students to be reflective who make decisions, inferences, and conclusions based on logic rather than emotion. Hence, they became capable of planning to analytically overcome the obstacles and barriers in their path toward their personal, interpersonal, and educational growth. In addition, they learned to accept different points of view logically and respectfully and cooperate actively with their classmates even though they hold different beliefs and behaviors. The findings of this study concur with other studies that support providing learners opportunities by which they become stakeholders in the learning process, engage and cooperate in the class activities, and express willingly and eagerly their thoughts and feelings, creating a much more positive atmosphere of learning (Alonso-Tapia & Nieto, 2019; Rahimi & Ebrahimi, 2011; Wang et al., 2020). Thus, the result of the current study is significant, as it is almost the first study to examine how CT affects a learning atmosphere. In fact, it revealed the importance of incorporating CT as one of the major factors in improving the quality of classroom climate. This was a major way to make it more positive by fostering an atmosphere in which learners freely express their views and emotions in an attentive and safe manner.

Regarding the third research question, Is the implementation of the CT-intervention program, 3Es, statistically effective in developing learners' reading comprehension, the statistical analysis revealed that the EG group outperformed the CG in reading comprehension. The results showed that CT implementation led the participants in the experimental group to outperform the control group in the post-reading tests confirming the fact that critical thinkers think beyond a simple reading of a string of words on the page and see reading comprehension as a process that necessitates them to deeply think about and engage in a text to gradually construct meaning (Din, 2020; Liu, 2017; Marzban & Barati, 2016). This trend in thinking means that to comprehend a text, one

employs both lower and higher levels of thinking, as other scholars affirmed (Din, 2020; Harida, 2016; Heidari, 2020). All these studies support that equipping language learners with critical thinking helps them read more precisely. This is done by drawing inferences, making deductive reasoning and logical interpretation, and seeking information from different sources. This helps them understand the reading text better. Furthermore, putting emphasis on the role of CT as a facilitator in pedagogical contexts, the significance of the current study's findings is that by integrating CT into the content of the class and improving the quality of instructional climate, the outcome of language learning was enhanced as well. In other words, by exploring and sharing what they think, feel, and have learned, the students developed a positive view of the classroom climate. In addition, their reading skills were improved.

In sum, this research demonstrated the positive impacts of 3Es CT framework implementation on EFL learners' critical thinking, EFL classroom climate, and reading comprehension. The study also confirmed that learning a language is not the only and final goal; rather, it can serve as a means by which learners improve some other desired skills to develop themselves not only academically and linguistically but also personally and socially.

Conclusion

The present study investigated the impact of implementing a Bloom-based CT-intervention program, 3Es, on EFL learners' critical thinking, attitudes toward classroom climate, and reading comprehension. The results provide insights into how a theoretical CT framework can be put into practice, which assists English language learners in acquiring critical thinking and promoting their academic (reading comprehension) and affective features (attitudes toward classroom climate). Moreover, the current study contributed to the body of CT findings, by indicating the influence of CT on the L2 classroom climate as a point of novelty. That is, by being equipped with CT, one is empowered not only cognitively, but also emotionally and psychologically. Being able to think critically, individuals become reflective and immediate problem solvers who make sound decisions once they encounter problems or challenges. Additionally, CT-based instruction enables students to form a reasonable opinion on matters surrounding them, such as classroom climate and its components, such as involvement and cooperation. In brief, critical thinking empowers learners to critically see and reflect on the received information, including the climate of the learning environment, and supports them in acquiring some other desired skills; therefore, there is a clear benefit to the inclusion of CT instruction in the L2 classrooms.

This research provides theoretical support for the effectiveness of Bloom's hierarchical model of critical thinking to serve as the foundation of CT instructional programs. It emphasizes the importance of mastering one skill before proceeding to the next. In addition, evidence was presented to support the context-dependent nature of any life skill program, particularly CT intervention frameworks and models, illustrating the fact that the effectiveness of intervention programs is determined by their context. Hence, if the context and requirements are considered, an effective shift from theory to practice can occur. Further, the findings of this study will redound to the benefit of society in general and EFL teachers and students in particular since CT leads the classroom and

school environment towards becoming a mini-critical society where the values of CT (truth, open-mindedness, empathy, autonomy, rationality, and self-criticism) are encouraged and rewarded. Moreover, it makes learners responsible for what and how they learn and gives them an active rather than passive role in the classroom. Therefore, the current study suggests some practical implications for EFL teachers, course designers, and material developers with the introduction and implementation of CT-provoking activities in textbooks and classroom content to offer rich educational opportunities and outcomes for learners to develop both linguistic and non-linguistic skills.

The results of the present study can contribute to existing research in this field but must be viewed considering its limitations. First, there was a limitation in the size of the sample in this study. It may be possible to draw some generalizable patterns from this study by using larger sample sizes in future studies. In addition, while the participants were recruited from intermediate English language classes, their English study experience varied widely. In addition, this study took a holistic view and did not measure skills and dispositions separately. The study was also limited to the skill of reading comprehension. Other linguistic skills and sub-skills, therefore, remained untested.

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Author contributions

ZBM designed the study, collected the data, & wrote the original draft. MHN cooperated in the study design, did the supervision, & Reviewed & Edited the study drafts. MT cooperated in the review & editing. All authors read and approved the final manuscript.

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Availability of data and materials

The raw data supporting the conclusions of this article will be made available by the authors.

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the Research Committee of Islamic Azad University.

Consent for publication

It was explained to the students that they could participate in the course even if they did not agree to be part of the research. During the project, students' participation was voluntary, and they received no remuneration. The participants were also informed that the study is intended to be published in a journal and the article findings would be shared with them.

Competing interests

The authors declare they have no competing interests.

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