Bulletin of Education and Research
December 2025, Vol. 47, No.3 pp. 107-123

Context Matters: Evaluating Domain Constraints on Critical Thinking

Nasir Mahmood* and Sumbal Asghar **

Abstract

Critical thinking skills allow students to reflect on their understanding by giving a substantial argument supported with proof for complex problems, not only in class but also in real-life situations. Critical thinking skills can be taught at different grade levels by embedding them within the content of any subject. However, there is no guarantee that the critical thinking skills, once learned within the framework of one subject, can be universally applied when the subject or the content changes. Therefore, the foremost aim of this study is to determine whether and to what extent critical thinking skills learned in one context can be transferred to another context. An intact class of grade 7 science students was taught three units from science textbooks. A pre-test, post-test technique was employed to record 'changes in critical thinking skills' at the end of each unit. After the intervention, post-test scores at the end of each unit were compared with the pre-test scores of the next unit to assess the transferability of critical thinking skills. There is insufficient evidence of the transferability of critical thinking skills when the content to be taught changes. Retention of critical skills, once learned, apparently fades when it is exposed to a new situation, but recollection improves with every exposure.

Keywords: Critical thinking skills, content dependency, transfer of learning, context specificity, science education

* Professor, Department of Science Education, Allama Iqbal Open University, Islamabad. Email: nasir.mahmood@aiou.edu.pk
** Assistant Professor, Department of Education, Virtual University of Pakistan, Lahore. Email: sumbal.asghar@vu.edu.pk

Cite this article:
Mahmood, N., & Asghar, S. (2025). Context matters: Evaluating domain constraints on critical thinking. *Bulletin of Education and Research, 47*(3), 107-123.

Introduction

In the contemporary changing world, educational reforms profoundly accentuate the progress of 21st-century skills, with critical thinking as the forerunner. While substantiation proposes that critical thinking can be efficaciously imparted to enhance student rationality (Emerson, 2013), a persistent challenge remains: reasoning skills do not naturally or extemporaneously transmit across different settings (Barnett & Ceci, 2002; Gelder, 2005). The shared educational supposition that a student who is trained in critical thinking in one situation will inevitably apply it to another is a momentous generalization (Davies, 2013; Willingham, 2007).

This conflict between the worldwide applicability and the domain-specificity of thinking skills is debatable since the epoch of Aristotle (Moore, 2011). Advocates of domain-specificity opine that critical thinking is profoundly content-dependent because logical evaluation depends deeply on circumstantial and context-specific knowledge (Brown, 1990; Dumitru, 2013). As a result, students frequently endeavor to employ these skills when confronted with novel content, as their understanding is commonly tied to the superficial structures of the original learning material rather than its fundamental structure (Willingham, 2019). While the National Research Council (2012) recognizes that intellect is transmittable, its range is highly limited without deliberate instruction.

This issue of transfer of cognitive skills poses critical queries for modern-day instructors: To what extent can students adapt what they learn across changing content lines? Is this transfer entirely content-dependent?

To address this gap, the chief emphasis of this research is to explore whether and to what extent critical thinking skills generalize and transfer to new conditions as the instructional content changes. Identifying the boundaries of context-dependent learning, this study aims to assist teachers in purposely planning curriculum distribution at a deeper structural level, which will guarantee that learners develop transferable cognitive capacities together with foundational subject knowledge.

Literature Review

The 21st century has blessed us with digital technology and a fast-paced environment where students need content knowledge as well as skills to work together and to address the problems of this ever-changing world. It is more than technological expertise. The National Association of Colleges and Employers (NACE) (2016) has also indicated the importance of critical thinking skills for employment by ranking these skills at the top. Therefore, students need to be innovative, creative, and adaptable to address the problems of this digital age. They need to think critically and rationally to understand the issues and to make difficult decisions. Teaching students to think, read, see, and hear critically has never been given so much importance before (Emerson, 2013). This is also consistent with various other research results, which pointed out that critical thinking skills lead to higher-order thinking and are important and need to be developed in students.

According to Gelder (2005), humans are not naturally critical, and if they were, even then it would still be difficult because it is a complex activity. That is why cognitive scientists call them higher-order skills. Sometimes students who can think critically do not even do so because they are neither able nor motivated to think critically about every single issue (Dunn, Halonen & Smith, 2009). Crain (2005) explained it in this way: people perceive first and then form a shape to think about. Whereas Ritchhart & Perkins (2005) viewed it in this way: humans make sense through simple familiar patterns and make stories. The problem comes when someone does not identify the pattern in the new situation and does not even know whether a pattern really exists there or not (Stanovich, West & Toplak, 2016). Hence, this ability to analyze and productively adapt to the new context is part of critical thinking (Changwong, Sukkamart, & Sisan, 2018).

Thinking critically means being able to examine problems at a deeper level, understand the concepts in depth, solve problems logically, and pursue alternative possibilities and solutions. Critical thinking has been defined in many ways by researchers, but basically, it has roots in "the Socratic method" of teaching. It is the ability to think rationally and clearly. Someone who identifies, develops, and evaluates arguments, understands the logical connection between the ideas, identifies discrepancies and common errors in reasoning, and solves problems systematically has critical thinking skills (Lau & Chan, 2004-2019). It is a rational procedure to actively and competently hypothesize, apply, examine, create, and assess information to conclude.

Hughes (2014) describes critical thinking as looking for evidence to support claims or beliefs through a process of investigation. It helps students to investigate the beliefs given by the teacher or experts and their own beliefs in the setting of their minds and actions. It is the ability to conclude from the information someone has and then to make the best possible use of that information to solve a problem. Whereas Bailin (2002) does not view critical thinking as an observable series of distinct steps or skills. He argues that the process of thinking is unobservable, but its product has some overt skills like analysis, explanation, and articulating good questions. Willingham (2007) describes it in a very detailed way. According to him, it is like viewing both sides of a problem, being ready to accept new suggestions that go against your ideas, reasoning objectively, accepting claims with evidence, deducing and inferring from existing facts, and solving problems. It helps students to think independently and make responsible and unbiased decisions while dealing with problems. Proper guidance can help the student to do this.

Undoubtedly, there is consensus among researchers that critical thinking skills can be developed among students through instruction and techniques. On the other side, teachers consider it a difficult process (Willingham, 2007; Wade, 2009). As said by Henry Ford once, "Thinking is hard work; that is why so few people do it" (quoted by Kurfiss, 1988). Critical thinking is built upon some simple or lower-order skills, which are easy to attain, and if these lower-order skills are not attained properly, it would be difficult to develop higher-order skills. Furthermore, these lower-order skills need to be skillfully practiced and combined into an integrated whole (Gelder, 2005). Even daily practice to make students habitually thinking about something will lead them to develop rational capacity and intellectual growth. Teaching critical thinking skills can be made successful by involving the situation in which the learning tasks are designed, stimulating thought, challenging supremacy, and revealing authority (Wang & Zheng, 2016). It is an effortful activity and requires acceptance of new ideas.

New information is continuously attacking us from all sides due to the advancement of technology, and we need to draw a line between important and unimportant information. Besides that, it is difficult to accept the new ideas and to reject the old perception (Zimmermann, 2005). At this time, the thinking process helps to master this new content, but that content needs time to be integrated with the previous one. Everyone's thinking process needs to be organized according to the new content because every new content needs a prerequisite thinking structure that was not already present in the learner's range (Sunbul, 2016). Willingham (2007, 2019) describes it several times. According to him, in cognitive science, once a material is learned, the mind understands it and becomes biased to make that knowledge inflexible. This understanding of knowledge is tied to the surface structure of that concept, but when the concept is changed, that knowledge becomes unavailable. Therefore, critical thinking is not a set of skills that can be organized at any time in any context. These skills are not like those that, once you learn them, you can apply to any situation.

Instead, critical thinking is the ability to change the scenario-based decisions made yesterday by using new information (Changwong, Sukkamart, & Sisan, 2018). Whenever we ask our students to look at the issue from multiple perspectives, they cannot do so unless they have enough prior knowledge of that issue. Prior or background knowledge is a combination of someone's life experiences that is used to connect the new information to the old one (Schallert, 2002). Background knowledge is very important in learning because it helps to make sense of new ideas and experiences. Someone who has background knowledge will be able to unlock the meaning of new information. (Marzano, 2004; Lent, 2012). Background knowledge is needed to make connections and to understand big ideas. Researchers have highlighted the role of prior knowledge in developing critical thinking skills in their studies several times. It may be knowledge of certain academic subjects, content, and facts, as well as principles, conditions, and methods related to the development of critical thinking skills (Santos, 2017).

Willingham (2019) also emphasized the importance of background knowledge for critical thinking. According to him, the processes of thinking and the content of thought (domain knowledge) are intertwined with each other. According to Ennis (1989), critical thinking skills are domain-specific in nature. Domain-specific knowledge is considered a prerequisite to critical thinking because explanations, evaluations, and evidence that are required in the process vary from one domain to another (McPeck, 1990; Willingham, 2007; Lai, 2011; Dumitru, 2013). Additionally, it is easy to learn to think critically within a given domain. Our ability to use logical reasoning is due to domain-specific knowledge. Woolfolk, Winne & Perry (2003) pointed out the possibility that critical thinking skills might be developed in one or more subjects and not in general. Thus, someone who is good at reasoning logically in science may not be able to do it in practical life or in any areas outside of science (Tricot & Sweller, 2013).

Many researchers advocated the development of subject understanding for developing critical thinking skills. McPeck (1990) describes critical thinking around the concept that its significant aspects apply only to specific subject-matter areas. Ennis (1989, 2013) elaborated three versions of subject or domain specificity of principles and concepts in critical thinking: conceptual subject specificity, epistemological subject specificity, and domain specificity. According to him, epistemological subject specificity and domain specificity both emphasize the importance of background knowledge. Furthermore, in domain specificity, critical thinking skills, once demonstrated in a situation, will not be applied in another situation unless it is taught to transfer. Ritchhart and Perkins (2005) also reported this argument that transfer is not possible due to the context-bound nature of knowledge in critical thinking. There is evidence of some degree of transfer across domains of content knowledge, but that did not occur naturally.

Critical thinking is examining deeply and interrogating what exists on the surface of the problem. The deep structure level is abstract and difficult for the students to grasp. Naturally, students will ask for examples to understand that level, which is difficult and needs guidance. Transfer of critical thinking skills across domains is not possible until students have sufficient practice to use these skills in different domains, and they are taught to transfer them to different domains. In other words, students need to be sensitized to the deep structure level of the problem instead of looking at the superficial aspects (Lai, 2011). There is evidence in the literature that explicit instructions and practice of applying knowledge undoubtedly improve the performance of students in tasks but do not help them to transfer critical thinking skills (Van Peppen et al., 2018).

Just have a look at the determination of the relevance of facts. The ability to differentiate relevant facts from irrelevant facts is dependent on subject matter. Rather, it is more situation-specific than domain-specific. This differentiation needs attention to the problem at hand and the factors that might stand in this issue. Similarly, in weighing evidence, the actual act is to understand the importance of many elements, which is totally dependent on content knowledge (Smith, 2002). The reason behind the problem of transfer of critical thinking skills is the domain-specific nature of critical thinking. Spontaneous transfer of these skills is rare to the new context (Pithers & Soden, 2000; Willingham, 2007). Many researchers come to an agreement that critical thinking skills cannot be transferred until students are taught to transfer. Willingham (2019) noted that critical thinking looks different in each subject, and it should be taught within a subject without having an expectation that students will transfer. He explained the problem of transfer in a very interesting way. According to him, people usually look at the superficial characteristics of the situations, probably because the surface structure is unconcealed. Whereas the similarities always lie at the deep structure level, which is not overt. So why do our teachers not focus on the deep structure level in teaching?

The problem of connection between deep structure and surface structure can be overcome if students have enough knowledge of the subject and see various examples connecting surface and deep structure to give a hint that it is that kind of problem. For example, students can be asked to compare two solved problems having different surface structures but the same deep structure. Detailed, specific knowledge of a subject will make it easy to solve problems in critical thinking. According to Brown (1990), domain-specific knowledge is very important to successfully transfer these skills to a new context with the same deep structure level. She concluded in her research that young children show meaningful learning and transfer based on deep structure levels rather than simple superficial features when they have enough domain-specific knowledge to facilitate that learning. Thus, teaching for transfer needs to provide relevant background information on the context.

Most experimental research confirms that background knowledge is necessary to reason scientifically (National Research Council, 2007). Prior knowledge influences the selection of the alternate solution as well as the interpretation of the information in the given context. The results of experimental research showed that there is a strong relationship between students' initial knowledge and what they learn in future sessions, and it was considered hard to teach critical thinking skills without domain knowledge. (Schauble, Glaser, Raghavan & Fugelsang, 2005). Almost more than 100 years ago, Charles Judd (1908) reported the result of his earlier research of him and Scholckow. Supporters of his ideas analyzed his results in a way that teachers should concentrate on broad principles and simplifications rather than exact facts, skills, and beliefs (cited in Barnett & Ceci, 2002).

Anyhow, a transfer may be designed by highlighting important features of the situation that need careful thought, encouraging a reflective concept of basic principles, and providing practice across multiple contexts. Even then, there are more chances to see near transfer of thinking to similar contexts than far transfers. Researchers put it this way: transfer can only occur if the teacher teaches it. Students need to practice this act of transferring skills from one context to another. Firstly, they may practice a primary critical thinking skill in a context and later take them to an abstract for themselves. Then give them a task to identify some other context or situation to apply that abstract situation (Ennis, 2013; Gelder, 2005).

Thus, the major problem in critical thinking skills is one of transfer. If students once learned critical thinking skills, would they be able to apply them in their practical and social issues outside the school or in their practical life? In other words, whether and to what extent these critical thinking skills, once learned, can be transferred to the new context. There is empirical evidence of both the failure and success of the transfer of these skills in research. Nickerson (1988) found mixed evidence on transfer of skills. He concludes that the transfer of critical thinking skills depends on the content that is taught and the method that is used to teach that content. As Halpern (2009) concluded in his research, students who acquired critical thinking skills in the context of a particular discipline applied them in an entirely new context several months after the course had ended. Many researchers mentioned that students can apply critical thinking skills in one context but are not able to apply them in another context (Willingham, 2007).

There is ambiguity in the degree of transfer, i.e., to what extent does this transfer occurs (Bailin, 2002). In other words, either this transfer occurs in a new but similar context or in an entirely new discipline. Gelder (2005) states that transfer of skills and knowledge does occur to some extent, but it does not occur up to our expectations. Otherwise, the whole process of education would become useless. Barnett & Ceci (2002) identify two important factors helping transfer. One is to be familiar with the deep structure of the problem, and second, to have the knowledge needed to look for the deep structure. This is a long-term activity and suggests to you that you must do, but it does not tell you to come up with alternative solutions and to assess how rational each one of them is. It requires domain knowledge and practice to use that knowledge to solve the problem (Willingham, 2007). Knowing how to think critically is not enough; it needs domain knowledge and practice also. However, we must look for methods to help our students be equipped to make sound decisions, see every possibility, curtail biases by making the best use of understanding, and contribute intelligently and efficiently to the global society.

Research Objectives:
The study aims to:

1. Determine the baseline of critical thinking skills among seventh-grade students in the science subject.
2. Find the change in critical thinking skills of students in the experimental group at all sub-stages of the experiment.
3. Investigate the extent to which students transfer critical thinking skills across different content areas and determine whether such transfer is content-dependent.

Research Methodology

This research was designed in a natural setting for instructional purposes. The study was quasi-experimental in nature and employed an intact group pretest-posttest control group design to minimize the threats to validity. The research used a questioning method as an instructional pedagogy to develop critical thinking skills. The focus of the research was to determine whether and to what extent critical thinking skills learned in one context can generalize and transfer to another context. The transfer of skills and knowledge was assessed by comparing the means of post-test achievement scores based on the concepts of a particular unit and pre-test achievement scores based on the concepts of the next unit. Generally, the study was to determine the extent to which critical thinking skills, after studying a unit, were applied while answering the questions for another unit.

Participants of the study

The study population comprised all students enrolled in Grade VII of the public and private schools of Lahore. School administration did not allow manipulation of teaching in the classrooms for a three-month-long intervention. So, there was no option left except for convenient sampling. There were nine sections of grade VII in the selected school; the experimental and control groups were randomly assigned. Intact groups of two sections were taken as the experimental and control groups.

Three units were included in the research as specified by the school administration for the term (six months' duration). There was no artificial arrangement for the research, as the researcher had no choice with respect to the topics taught. The included units were mixtures, solutions, and simple chemical reactions prescribed by the school administration, which were taught by using questioning as an instructional pedagogy.

Instrumentation

Pre-tests and post-tests were administered to assess students' transfer of critical thinking skills related to the concepts covered in the selected units. The content validity of the tests was ensured using a table of specifications describing the distribution of questions by levels of learning. Subject experts were consulted for the content of the units with their learning outcomes. Self-developed worksheets by the researcher were used as a pre-test and post-test, which were presented to the panel of experts for discussion. This discussion took almost one week per worksheet to discuss questions with their learning outcomes and to cover the indicators used to measure the development of critical thinking skills.

Each test contained 5-6 unseen questions based on the topics included in the unit. Each question had sequential parts where the answer to each subsequent part was based on the answer given in the previous part. Both the experimental and control groups were given the same test once before studying the unit and then after completing the unit as a pre-test and post-test. As three units, mixtures, solutions, and simple chemical reactions, were included in the research, each unit had a separate worksheet, which was used as a pre-test and post-test for that unit.

Results

The study was carried out in three phases. In each phase, three separate pre- and post-tests were conducted to assess two fundamental critical thinking skills. Data was analyzed independently for each phase as well as collectively for the entire study period. As the study was to determine the transfer of developed critical thinking skills from one context to another context, the comparison of results of a taught unit and pre-test scores of the next unit (to be taught) was used. Data analysis was carried out by applying statistical techniques of mean, standard deviation, and percentage. The Friedman test was used to examine overall differences in critical thinking skills across the three phases, while the Wilcoxon signed-rank test was performed for pairwise comparisons to determine where the significant differences existed.

The comparison of the results of post-test scores and pre-test scores did not show that critical thinking skills, once developed in post-test scores of a unit, transferred while answering the questions for pre-test scores of the next units.

Table 1

Unit-wise Mean Scores and Standard Deviation for "Supporting Responses with Reasons" for the Control and Experimental Groups

Chapter	Type of Group	N	Pre-test scores			Post-test scores			Difference
			Mean	S.D.	Mean (%age)	Mean	S.D.	Mean (%age)	
Mixture	Control	24	22.12	7.21	30.72%	32.54	7.48	45.19%	14.47%
	Experimental	24	19.25	3.84	26.74%	46.29	11.40	64.29%	37.55%
Solution	Control	23	16.08	10.08	16.24%	39.12	17.58	39.52%	23.28%
	Experimental	24	6.62	5.37	6.69%	67.67	16.32	68.35%	61.66%
Simple Chemical Reaction	Control	24	16.58	12.92	10.84%	31.17	16.81	20.37%	9.53%
	Experimental	23	7.96	9.76	5.20%	89.29	31.66	58.36%	53.16%

It is evident from the data analysis that the control group improved its performance from 30.72% to 45.19%, whereas the experimental group improved its performance from 26.74% to 64.29% during the first phase of the study. During the second phase of the research study, the control group improved its score from 16.24% to 39.52%, whereas the experimental group improved its performance from 6.69% to 68.35%. During the third phase of the study, the control group improved its performance from 10.84% to 20.37%, whereas the experimental group improved its performance from 5.20% to 58.36%. There were three indicators of the "supporting responses with reasons" skill: (i) use evidence to illustrate argument/conclusion, (ii) clarity of response, and (iii) give a reasoned conclusion.

The comparison of the mean percentage of post-test scores of the experimental group, 64.29%, during the first phase, and the mean percentage of pre-test scores of the second phase, 6.69%, shows that students were good at supporting responses with reasons in their post-test of the first phase due to intervention, but they were not so good at supporting their responses with reasons in their pre-test when exposed to the new content of unit 2. Similarly, the comparison of the post-test scores of experimental groups, 68.35% during the second phase, and the mean percentage of pre-test scores of the third phase, 5.20%, shows that students used these skills in the post-test of the first phase due to the intervention, but they were not able to use these skills when exposed to the content of Unit 3. The same pattern can be seen in the control group.

Table 2

Unit-wise Scores for "Supporting Responses by Evidence" for the Control and Experimental Groups

	Type of Group	Pre-test scores				Post-test scores				Difference in Percentage
		Mean	Mean (%age)	N	S.D.	Mean	Mean (%age)	N	S.D.	
Mixture	Control	57.62	44.32%	24	13.24	75.42	58%	24	12.57	13.68%
	Experimental	55.12	42.2%	24	6.24	92.71	71.32%	24	15.33	29.12%
Solution	Control	48.37	29.31%	24	14.46	81.58	49.44%	24	24.51	20.31%
	Experimental	35.04	21.2%	24	9.42	122.38	74.17%	24	23.28	52.97%
SCR*	Control	71.79	28.15%	24	17.53	91.96	36.06%	24	22.42	7.91%
	Experimental	57.50	22.54%	24	13.36	167.12	65.57%	24	46.46	43.03%

Note. *Simple Chemical Reactions

Table 2 shows that the control group improved its scores from 44.32% to 58%, whereas the experimental group improved its scores from 42.2% to 71.32% at the end of the first phase. The control group improved its scores from 29.31% to 49.44%, whereas the experimental group improved its scores from 21.2% to 74.17% at the end of the second phase. During the third phase of the study, the control group improved its performance from 28.15% to 36.06%, whereas the experimental group improved its performance from 22.54% to 65.57% during the same phase. There were two indicators for "supporting responses by evidence": relevance and consistency.

The comparison of the percentage of mean scores of the post-test scores, 71.32%, at the end of the first phase and the pre-test scores of the second phase, 21.2%, of the experimental group shows that students showed good performance in supporting their responses with evidence in their post-test scores due to intervention, but they were not so good in supporting their responses with evidence in their pre-test scores of unit 2 due to the new content. Similarly, the comparison of the post-test scores at the end of the second phase, 74.17%, and the pre-test scores of the third phase, 22.54%, showed that students were good at supporting their responses with evidence at the end of the second phase but could not use this skill when they were exposed to the new content of the pre-test of Unit 3. The control group also shows the same pattern.

Size of Change during Three Phases

The Friedman test & Wilcoxon test were run on the percentage of mean scores.

Table 3

Pre-test and Post-test Performance of Experimental Group During Three Phases of Study

Test Scores	N	Mean	S.D.	Mean rank	Chi-square	df	Asymp. sig.
Pre-test (Mixture)	24	34.52	6.85	3.09	99.65	5	.000
Post-test (Mixture)	24	67.48	12.68	5.09			
Pre-test (Solution)	24	12.14	5.9	1.61			
Post-test (Solution)	24	72.98	14.99	5.39			
Pre-test (SCR*)	24	11.00	5.66	1.39			
Post-test (SCR*)	24	59.47	19.63	4.43			

Note. *Simple Chemical Reactions

Discussion and Conclusion

The change in the post-test scores of the experimental group shows that these skills were developed because of the intervention, and this happened in all three phases of the study. This phenomenon revealed that students learned to use critical thinking skills due to the intervention in their post-test, and it was seen in post-test scores of all three phases. However, the comparison of the post-test at the end of each phase and the pre-test of the next phase shows a decline in the pre-test scores of the experimental group. The same phenomenon has been observed in the second and third phases of the study. Though they performed very well in their post-test of the previous unit, they could not perform properly in their pre-test of the new unit. This decline in the pre-test scores shows that students have difficulty using these skills when they are exposed to the new content. A slight change in the post-test scores of the control group was also observed, which shows that once they get used to the content or the concept, they can think critically or give reasons, obviously not on the scale on which they can do so with training. Generally, young people have the natural ability to think, but they might not be accustomed to employing these skills always.

Critical thinking is a learned ability and a complicated process. One of the biggest challenges is learning this skill in one situation but finding it difficult to apply in another situation. In a new situation, new knowledge is needed to apply these skills, and new knowledge is built on background knowledge of the situation. The ability to use these skills depends on the level of expertise and the knowledge of the content. It denotes that these skills are content-dependent. The change in the post-test scores of the control group also highlights this point that simple exposure to the content during the phase helped to build the background knowledge to use the natural ability of thinking. Considering the importance of the content, the teaching of content should be thought-provoking rather than rote learning.

Similarly, the students of the experimental group learned to apply the critical thinking skills in their post-test because of the intervention, but they found it difficult to apply those skills in the pre-test of the new unit without having the knowledge of the content. Whenever the students are exposed to a new situation, they are unable to comprehend it from multiple perspectives because they do not have enough prior knowledge of the situation. That prior knowledge can be their reading and their life experiences, which can connect the new knowledge to the old knowledge. Someone who has that prior knowledge will make this connection and be able to get the big ideas (Bosch et al., 2021). It is just as we face a new problem, we always look at it from all perspectives to decide. If we do not have enough knowledge, then we try to get that knowledge, and then we consider all the pros and cons to decide. That is exactly what happens to the student as well when he/she is exposed to the new content. He cannot reason or think logically or to make decisions without enough knowledge. As soon as he gets the knowledge of the content.

Thus, it is concluded that critical thinking skills, once learned in one context, do not transfer to a new context. These skills can be transferred only if the students have enough prior knowledge of the context.

Recommendations

1. Critical thinking instructions should be integrated across different subjects instead of focusing on a single subject to promote the transfer of these higher-order skills across different learning contexts.
2. Teachers should focus on teaching students to apply the strategies to use these skills in new and different contexts.
3. Interdisciplinary learning activities should be incorporated into the curriculum to encourage students to use these higher-order skills across different content domains.
4. Future research may be conducted to explore the factors facilitating or hindering the transfer of critical thinking skills across different disciplines and contexts, using prior knowledge of the students and instructional approaches.

References

Alsaleh, N. J. (2020). Teaching critical thinking skills: Literature review. *Turkish Online Journal of Educational Technology*, *19*(1), 21-39.

Bailin, S. (2002). Critical thinking and science education. *Science & Education, 11*(4), 361–375.

Barnett, S. M., & Ceci, S. J. (2002). When and where do we apply what we learn? A taxonomy for far transfer. *Psychological Bulletin, 128*(4), 612-637.

Bosch, E., Seifried, E., & Spinath, B., 2021. What successful students do: Evidence-based learning activities matter for students' performance in higher education beyond prior knowledge, motivation, and prior achievement. *Learning and Individual Differences*, *91*(2), 102056.

Brown, A. L. (1990). Domain-specific principles affect learning and transfer in children. *Cognitive Science, 14*, 107 – 133.

Changwong, K., Sukkamart, A., & Sisan, B. (2018). Critical thinking skill development: Analysis of a new learning management model for *Thai* high schools. *Journal of International Studies, 11*(2), 37-48.

Crain, W. C. (2005). Theories of development: Concepts and applications (5th ed.). Upper Saddle River, NJ: Pearson Education.

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B. & Osher, D. (2019). Implications for educational practice of the science of learning and development, *Applied Developmental Science,* DOI: 10.1080/10888691.2018.1537791

Davies, M. (2013). Critical thinking and the disciplines reconsidered. *Higher Education Research Development. 32*, 529–544.

Dumitru, D. (2013). The transfer and the transferability of critical thinking. *Transylvanian Review, 22*(3), pp. 142-148.

Dunn, D. S., Halonen, J.S., & Smith, R. A. (2009). Engaging minds: Introducing best practices in teaching critical thinking in psychology. In D. S. Dunn, J. S. Halonen, & R. A. Smith (Eds.), Teaching critical thinking in psychology: A handbook of best practices (pp. 1-8). Hoboken, NJ: Wiley-Blackwell.

Emerson, M. K. (2013). A Model for Teaching Critical Thinking. *Online Submission.* Available at: https://files.eric.ed.gov/fulltext/ED540588.pdf

Ennis, R. H. (1989). Critical thinking and subject specificity: Clarification and needed research. *Educational Researcher, 18*(3), 4–10.

Ennis, R. H. (2013). 'Critical thinking across the curriculum.' *Virtues of Argumentation (OSSA),* 22 – 25 May. Windsor, ON: OSSA, pp. 1 - 16

Gelder, T. V. (2005). Teaching Critical Thinking: Some Lessons from Cognitive Science. *College Teaching*, *53*(1), 41-48 http://dx.doi.org/10.3200/CTCH.53.1.41-48.

Halpern, D. F. (2009). Foreword. In D. S. Dunn, J. S. Halonen, & R. A. Smith (Eds.), Teaching critical thinking in psychology: A handbook of best practices (pp. xv-xvi). Hoboken, NJ: Wiley-Blackwell.

Hughes, C. (2014). Theory of knowledge aims, objectives and assessment criteria: An analysis of critical thinking descriptors. *Journal of Research in International Education 13*(1). 30-45

Kurfiss, J. G. (1988). Critical thinking: Theory, research, practice, and possibilities (Report No. 0-913317-44-6). Washington, DC: Association for the Study of Higher Education.

Lai, E. R. (2011). Critical thinking: A literature review. Research Report. London: Parsons Publishing.

Lau, J., & Chan, J. (2004-2020). What is critical thinking? Retrieved from http://philosophy.hku.hk/think/critical/ct.php

Lent, R. C. (2012). *Overcoming Textbook Fatigue: 21st Century Tools to Revitalize Teaching and Learning.* Alexandria, Va: ASCD.

Marzano, R.J. (2004). *Building background knowledge for academic achievement: Research on what works in schools*. Alexandria, VA: ASCD.

McPeck, J. (1990). *Teaching critical thinking: Dialogue and dialectic*. New York: Routledge.

Moore, T. (2011). Critical thinking and disciplinary thinking: A continuing debate. *Higher Education Research & Development, 30*(3), 261–274.

National Association of Colleges and Employers. (2016). Class of 2016 believes it is "Career Ready," but is it? Retrieved from http://tinyurl.com/ya8a559g

National Research Council (2007). *Taking science to school,* Washington, DC: National Academy Press.

National Research Council (2012). *Life and Work: Developing Transferable Knowledge and Skills in the 21st century.* Washington, DC: National Academy Press.

Nickerson, R. S. (1988). On improving thinking through instruction. *Review of Research in Education, 15*(1988-1989), 3-57.

Pithers, R. T., & Soden, R. (2000). Critical thinking in education: A review. *Educational Research, 42*(3), 237-249.

Ritchhart, R. & Perkins, D. N. (2005). Learning to think: The challenges of teaching thinking. *The Cambridge Handbook of Thinking and Reasoning*

Santos, L. F. (2017). The role of critical thinking in science education. *Journal of Education and Practice, 20*(8), pp. 159-173.

Schallert, D. (2002). Schema theory. In B.J. Guzzetti (Ed.), *Literacy in America: An encyclopedia of history, theory and practice* (pp. 556–558). Santa Barbara, CA: ABC-CLIO.

Schauble, L., Glaser, R., Raghavan, K., & Fugelsang, J. A. (2005). Causal models and experimentation strategies in scientific reasoning, *The Journal of Learning Science, 1,* 201-238.

Smith, G. F. (2002). Are there domain-specific skills. *Journal of Philosophy of Education, 36*(2), pp. 207-227.

Stanovich, K. E., West, R. K., & Toplak, M. E. (2016). *The Rationality Quotient: Toward a Test of Rational Thinking.* Cambridge, MA: MIT Press.

Sunbul, A. M. (2016). Critical thinking and how to teach critical thinking. In Z. Kaya & S. Akdemir (Eds.), *Learning and teaching theories, approaches and models*. Ankara, Turkey: Cozum Egitim Yayincilik.

Tricot, A., & Sweller, J. (2013). Domain-specific knowledge and why teaching generic skills does not work. *Educational Psychological Review, 26*(2), pp. 1-38.

van Peppen, L. M., Verkoeijen, P. P. J. L., Heijltjes, A. E. G., Janssen, E. M., Koopmans, D. & van Gog, T. (2018). Effects of Self-Explaining on Learning and Transfer of Critical Thinking Skills. *Frontiers in Education, 3.*

Wade, C. (2009). Critical thinking: Needed now more than ever. In D. S. Dunn, J. S. Halonen, & R. A. Smith (Eds.), Teaching critical thinking in psychology: A handbook of best practices (pp. 11-21). Hoboken, NJ: Wiley-Blackwell.

Wang, X., Zheng, H. (2016). Reasoning critical thinking: Is it born or made? *Theory and Practice in Language Studies, 6*(6), pp. 1323-1331.

Willingham, D. T. (2007). Critical thinking: why is it so hard to teach? *American Educator. 31*, 8-19.

Willingham, D. T. (2019). How to teach critical thinking. The International Educator. Retrieved from https://www.tieonline.com/article/2593/daniel-willingham-on-teaching-critical-thinking

Woolfolk. A. E., Winne, P. H., & Perry, N. E. (2003). Educational psychology (2nd ed). Canada, ON: Allyn and Bacon.

Zimmerman, C. (2005). *The development of scientific reasoning skills: What psychologists contribute to an understanding of elementary science learning*. Report to the National Research Council Committee on science learning kindergarten through eighth grade. NY: National Research Council.