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Improving Student Critical Thinking Skills Through Explicit Teaching Strategies

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Abstract

This action research project aimed at finding the impact of teaching critical thinking skills through teacher modeling, guided practice, and independent activities. The eight-week intervention took place with a third grade group of students in a midwest suburban elementary school. Data was collected before the intervention, at the midpoint of the eight weeks, and then after the intervention was completed. Student self-assessment surveys as well as teacher observations were used to gather data around both the application of skills and the student confidence levels of that application. Through the interventions that were implemented, students showed positive growth in both confidence levels and the specific skills of critical thinking.

Keywords: critical thinking, critical thinking skills, student empowerment, depth and complexity icons

Students should develop their critical thinking skills in elementary school in order to fully utilize those skills throughout their educational careers as well as post-academic careers. Many "... successful students naturally raise questions about the material they read, make predictions, reflect on the sense and meaning of the story, and wonder and question further about what is happening" (Rothstein & Santana, 2018). Students have a natural ability to look at the world critically but will lose those skills over time if they are not practiced and honed through explicit teaching (Rothstein & Santana, 2018). When students are only required to use surface level knowledge and comprehension, that is the set of skills that will develop. Educators want their students to demand evidence and analyze that evidence, and we need to teach them how to do it through carefully crafted learning experiences.

This action research project explores the actions of explicitly teaching the eleven types of critical thinking skills, how to implement them within the questions teachers ask during discussions, and the use of non-verbal communication through the Depth and Complexity icons (DCI) developed by Sandra Kaplan (2012) (see Appendix A). The eleven skills are listed below in alphabetical order.

- Across Disciplines - The skills from a specific strategy or skill that can be utilized across subjects and content areas, connecting different disciplines and skills to apply to new situations.
- Big idea - This covers the theme or the main idea of a concept that is built upon the details students learn about a topic. Students synthesize their new learning to develop the big idea.

- Details - These are the facts about a topic and help students build their understanding of that topic or content area. Using this information, students develop the big idea of a concept.
- Ethics - This is the development of an understanding of the nuances of a topic in relation to the right and wrong aspects for the individuals involved.
- Language of the Discipline - This is the vocabulary used by experts and professions in the field of content being studied.
- Multiple Perspectives - This skill helps students to gain insight by learning about the experiences of others.
- Over Time (Change) - This skill is the pattern of how our understanding of a topic has changed over a period of time and requires students to look at the big idea of a concept and how growing our understanding of that topic has occurred over a period of time.
- Rules - These are the guidelines that must be followed for a particular subject or skill. Students develop these rules as they build their understanding of a topic.
- Trends - This is the pattern that develops over a long period of time.
- Patterns - Are the repeated aspects of a topic and the understandings of those repeated aspects.
- Unanswered Questions - This skill is looking at the questions that are left unanswered after research or discussion is done.

These icons are used as notes or visual reminders of the type of thinking that needs to be done as well as what types of thinking are connected to those ideas. Students will learn about

these types of critical thinking and then begin to apply these skills across content areas and learning spaces.

The research for this action research project was based in an elementary school over a period of four months. Students in the Elementary Advanced class met with the teacher once a week for 30 minutes in small groups for lessons and then returned to their regular classroom to apply what they had learned. Throughout these lessons, students were given opportunities to experiment with their new skills in a safe and brave space for failure to develop these skills.

I hypothesized that if elementary students are explicitly taught these types of critical thinking and how to recognize when they are utilizing them, that their ability to problem solve in a critical way will improve over time. As students begin to synthesize these skills into their everyday lives, the adults in their lives will begin to see an improvement in their problem solving abilities.

Theoretical Framework

Improving student understanding of their own abilities in critical thinking and higher level thinking skills involves a combination of student empowerment, teacher empowerment, developed questioning skills, and a safe space for students to receive and grow through feedback (Rothstein, Santana, & Puriefoy 2017). The framework that this action research paper is based on, Kaplan's Depth and Complexity (2012)**,** involves all of the above pieces with an emphasis on student empowerment to better understand and meet their own learning needs in a variety of learning environments. There are four themes that are supported by researchers: students should become contributing members of society, teachers should scaffold within their lessons for critical thinking, students should learn the art of argumentation, and teachers should create a setting

within their classroom that supports growth mindsets and room for practice of critical thinking skills (Rothstein, Santana, & Puriefoy 2017 and Florea & Hurjui 2015).

In order for students to become contributing members of society, Peterson (2019) discusses the student needs to develop higher order thinking skills in order to be positive and productive members of society. If we want to have a high functioning and productive society, then our citizens need to be critical problem solvers in order to positively impact our future. Through the use of student-led discussions our students will be empowered in their own learning and develop their own confidence to be those critical thinkers (Peterson, 2019).

Teachers should implement scaffolding within their teaching for students to build their critical thinking skills and questioning strategies are vital to critical thinking development. Vogler (2005) discusses how to build questioning strategies for both teachers and students while building upon lower order thinking to develop higher level thinking. These strategies include question taxonomies, and question sequence and patterns. Question taxonomies are a continuum of thinking from the basic, surface level questions to deep and complex questions that require research and rich discussion (Vogler, 2005). Question sequencing and patterns is a process of building questions upon each other, asking more and more difficult or in-depth questions throughout the discussion. These are strategies that both teachers and students can utilize within whole group or small group discussions to work towards higher order thinking. Rothstein and Santana (2018) believe that if we build on the natural curiosity and abilities of students they will inherently develop the critical thinking skills we want them to develop to be successful problem solvers. This belief, coupled with Vogler's ideas, present a strong argument for utilizing student curiosity with teacher scaffolding to allow students the opportunity to discover skills on their own.

Understanding the important use of argumentation is something students should gain through the learning of critical thinking skills. Savage (1998) discusses the need students have to learn how to defend their ideas and positions, as this can be done through teaching critical thinking skills and allowing space for students to develop their defense. When students have to defend their positions and ideas through the use of facts and well thought out responses, they are building their critical thinking skills at the same time.

Finally, educators need to develop a setting within their building or classroom that supports a growth mindset and room to practice the skills students are learning. Wang, Matsumura, and Correnti (2017) and Florea and Hurjui (2015) believe that through constructive feedback educators can empower students to take risks and develop a safe space for failure in our classrooms and learning environments. Feedback, true feedback, is vital for students to be able to understand their own positions on specific topics as well as learn to defend themselves (Savage, 1998).

This action research paper utilizes specific vocabulary when discussing the various types or strategies of critical thinking, the most important being the definition of critical thinking, which is the ability to analyze evidence and make decisions based on multiple sources of information. When educators are explicitly teaching vocabulary, modeling the behavior, scaffolding the skills, supervising practice, and giving opportunities for independence in our students, we offer space for students to develop and utilize their higher order thinking, which means synthesizing background knowledge with new learning to develop new understanding of a concept.

Literature Review

Improving Student Critical Thinking Skills

The literature suggests that there are specific strategies teachers can implement to improve student critical thinking skills including: teaching students and teachers how to phrase and ask higher-order questions, creating a safe and brave space for students to take risks, and teaching mini-lessons for specific skills. Students continually develop their critical thinking skills throughout their elementary career to help them better understand the world around them and how to solve problems as they grow.

Students in the Elementary Advanced Academics class have shown that they need help improving their ability to access higher-level thinking strategies and critical thinking in their general education classes. This literature review will answer the essential question: What teacher strategies help students know when to apply higher-level critical thinking skills? Since "critical thinking is learning to interact with information actively to bring pros and cons, evaluate them to determine the truth, transform information and generate new ideas" (Florea & Hurjui, 2015, p. 566), interactive lessons and activities are needed in order to build these skills.

"For today's students to be ready for the challenges of a rapidly changing world, instruction needs to move them beyond foundational skills and knowledge acquisition to critical engagement with texts and the world" (Peterson, 2019, p. 35). There are various techniques and strategies in the world of critical thinking that can improve a student's understanding, but which ones are the most effective and appropriate for elementary students?

Reviewing the various strategies, theories, and teaching philosophies for enhancing students' critical thinking skills shows many ways to help improve students' ability to apply critical thinking strategies. These methods can be implemented in all units of study or content areas. Research suggests that there are specific strategies that teachers can implement to improve student critical thinking skills, including questioning techniques by both the teacher and the

students, written feedback to allow for more in-depth reflection for students, creating a space where failure and risk-taking are embraced, and empowering students to lead their discussions and learning.

Questioning Techniques

Using specific and content-analyzing questions improves student engagement in critical thinking in various situations and learning spaces (Vogler, 2005). One of these specific ways is the concept of question sequencing. "Question sequencing is a series of questions designed so that each question builds on the answer to the previous one" (Vogler, 2005, p. 99) There are six ways to sequence questions, and they all contain the idea of building upon previous questions or ideas (Vogler, 2005). As the discussion continues, the conversation should be building to higher-order thinking which can be achieved through thoughtful sequencing of questions.

Another way to improve questioning techniques is through specific teacher training in questioning and facilitating learning (Savage, 1998). As teachers learn to ask questions, they discover that "Questions that elicit critical thinking usually do not have one best correct answer" (Savage, 1998, p. 291). Also, as teachers develop their teaching techniques to get students to defend their ideas, look for multiple perspectives, and go beyond the learning of facts their students will gain much more than what is in the textbook (Savage, 1998). Developing a thinking classroom increases students' ability to think critically about problems as they are presented to them.

Students should take an active role in developing higher-level questions for their student-led discussions and responses which can be done through explicit instruction of how to write questions, including sentence stems. "Higher order questions could also be generated by the students as they formulated their own ideas about the themes or big ideas of texts. The

students' questions could then be used to stimulate conversation within student-led discussions" (Peterson, 2019, p.37). Developing their ability to generate higher level questions is vital for students in developing their critical thinking skills because it allows them the opportunity to have ownership over their learning and to be active participants in all phases of the learning process. (Peterson, 2019). Students are often consumers of knowledge instead of creators/developers of the learning.

Providing Feedback

By implementing the use of specific feedback, students will begin to develop reflective critical thinking skills in a variety of settings. This includes the use of specific written feedback in writing assignments, which should be focused on the content of the writing. Students should develop new ideas from thinking about the text in a more complex way than surface level questions would allow (Wang, Matsumura, & Correnti, 2017). With this development, students will continue to build their capacity to think critically about the world around them. Teaching students how to provide feedback for their peers constructively and authentically is a skill set that needs to be explicitly taught to students in order for them to access the tools needed to critique their peers constructively.

> Utilizing feedback in the form of questions to probe further into the content and build connections between students and content will continue to increase student ability to think critically (Stanley, 2021). As students ask questions, they can synthesize their learning to develop those questions better which allows others to reach out further and gain understanding from multiple perspectives. Many "... successful students naturally raise questions about the material they read, make predictions, reflect on the sense and meaning of the story, and wonder and question further about what is happening"

(Rothstein & Santana, 2018, p. 17). Capitalizing on students' natural curiosity and excitement for learning is a large part of developing critical thinking skills. When teachers ask for more information or a student defends their thinking, students have a chance to apply those skills.

Safe Spaces to Take Risks

Another part of developing critical thinking skills is offering a safe and brave space for students to fail and take risks in a way that will allow them to build their skills.According to Florea and Hurjui (2015), the teacher is responsible for creating a space that is open to exploration and encourages students to try new ideas and strategies with the understanding that they are supported by the educator, both emotionally and through their own knowledge. By empowering students to take risks, teachers can empower them to take ownership of their learning and when students are active participants in their learning, they grow (Florea & Hurjui, 2015). These are vital skills for the future and when students develop them in elementary school, they can apply them throughout their lives.

The question then becomes, how can students collaborate together to engage in higher-level thinking to build a community of learners? Building a community of learners through higher-level thinking is all connected to the idea of engaged students and how they can feel connected to their learning. Student engagement increases student learning when students are empowered in their learning and take an active role in making meaning from their work (Peterson, 2019). Students are better able to think critically when collaborating to share ideas and perspectives. Working together builds stronger connections between students and content, including the ability to think critically.

Student-Led Discussions

Empowering students to lead discussions and take ownership over their own learning helps them build connections and delve deeper into their critical thinking skills. Teachers should teach specific skills and strategies, such as sentence starters, to help students build their collaboration capacity. "When structures are in place that encourages students to talk with each other rather than addressing all their comments to the teacher, the students are more likely to develop a sense of self-efficacy and ownership in their own learning" (Peterson, 2019).

Combining multiple methods and strategies along with student-led discussions, such as teacher modeling or roleplaying, enhances student ability to apply critical thinking skills. Creating authentic experiences for students empowers them to apply the critical thinking skills they have learned. (Abrami, Bernard, Borokhovski, Waddington, Wade, & Persson, 2015). The ability to ask thought-provoking questions by teachers and students is important to building critical thinking skills. Students need to learn how to question the world around them, how to look at issues and problems from multiple perspectives, and how to synthesize information to help them answer those questions. Building this capacity will benefit students far beyond the classroom and the grade-level content, and will help them build the skills necessary to think critically about the world around them.

In summary, the utilization of specific feedback from the teacher and peers can take the learning students have mastered from their questioning phase and transform it into knowledge by asking them to reflect (Wang, Matsumura, & Correnti, 2017). One of the arguably most integral vital strategies for helping students develop their critical thinking skills is building and maintaining a safe and brave space for students to work together. When students feel safe to take risks and try new ideas, they are more able to think critically about the world around them.

Teachers are the facilitators of learning for students, and implementing the strategies discussed in this literature review will help them continue that work. Students need to see teachers as a guide through their learning process, not the holder of all the knowledge.

Methodology

This study used participatory action research methods to collect information in a third grade advanced academic education class consisting of 18 students in a suburban midwestern school. The definition of advanced students for this study consisted of the top 15% of the grade level on the following data points : FastBridge aReading and aMath tests, classroom unit tests, and other classwork grades like writing samples or creative projects that were graded using a rubric that were entered into the district data collection program called Illuminate. The group of students was 40% female and 60% male, including students who qualified for English Language services and one student who also received Special Education services. This research occurred over a period of four months, meeting for 30 minutes, once a week. The intervention method involved explicitly teaching the eleven types of critical thinking skills (Byrd and Van Gemert, 2020; Kaplan, 2012) to third grade advanced students through modeling and guided instruction.

Students spent the first three sessions learning the definition of each type of critical thinking skill and writing down specific examples of that type of thinking in their school binders and identifying the icon used to represent each skill. All students kept their work in a school binder for ease of access as we were working. The next three sessions were spent with the teacher modeling each type of critical thinking through pre-written questions which were shared visually on the board for students to read and think about alongside the teacher. First, the question and situation were displayed on the board, then students were asked what type of

critical thinking skills would be needed to solve the problem. After the teacher modeled her thinking, students modified their answers as needed.

After introducing the eleven skills, students were asked to determine and label the types of critical thinking they were asked to access during whole class instruction in their regular classrooms throughout the day. Students drew the icon that matched the type of thinking on the margin of their paper or on an index card to be shared later with the whole class during small group discussions or whole group sharing.

In the final weeks of the research, students created their own flashcards of the eleven types of critical thinking and wrote the definitions in their own words. These flashcards were evaluated by the teacher through the use of a rubric (see Appendix D) to determine mastery of the content. Then students took the flashcards home for continued review over the summer months.

Data was collected throughout the research process including gathering baseline data, observational data, and formative and summative assessments. During the first session with this group of students, each student filled out a pre-assessment on their confidence in using specific types of critical thinking skills and then another pre-assessment to show their understanding of the different types of critical thinking (see Appendix E and F).

From this baseline data and after explicitly teaching the eleven types, students took a mid-assessment as a formative assessment in both confidence and application of skills to show what learning growth had occurred. Students also turned in the worksheets they had completed of each type of thinking and the examples they found for that specific type of critical thinking, which were reviewed by the teacher as a quick formative assessment to guide the teaching of the next session.

Throughout the sessions, observational data was collected in the form of teacher observation in small group discussions through an observational matrix (see Appendix B). As students discussed the topic listed on the board, the teacher monitored and recorded each time the specific type of critical thinking was used.

Finally, the summative assessment had two parts, a post-assessment of both confidence and application of skills and student created flashcards (see Appendix C). Students took the same survey that they completed as a pre- and mid-assessment, which showed the growth of the students as a whole group over the course of the research. Secondly, the students created flashcards that showed the icon and name of a skill with a definition in the students' own words on the reverse. Both of these summative assessments revealed how much the students had grown in their understanding of critical thinking skills and how to apply them.

Analysis of the Data

The unit for this research study was created utilizing the work of Byrd and Van Germert (2019), Kaplan (2012), Rothstein, Santana, and Puriefoy (2017), Stanley (2020), and Vogler (2005). The lessons consisted of modeling by the teacher of reactions to various scenarios to explicitly teach the DCI. Then moving into guided practice where students worked to analyze and label the eleven types of critical thinking skills in small groups or individually with small group discussions immediately following their work. Finally, students were released to independent practice so they could apply the skills and understandings that they had synthesized during the research window. This application took place as individuals but the students also discussed their thoughts with others throughout the activity. Qualitative and quantitative data tools were utilized to collect data throughout the research process.

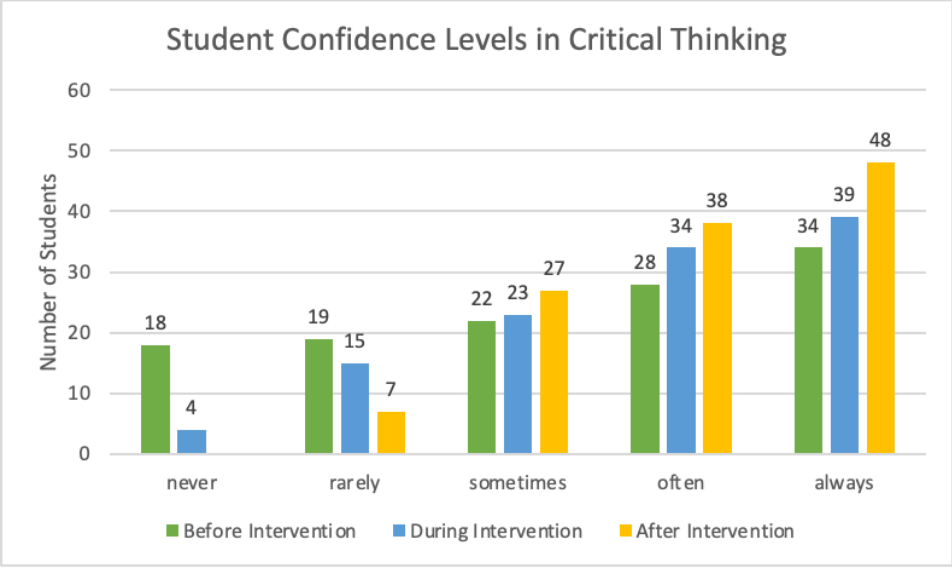
One of the data tools utilized was a student confidence survey (see Appendix E) to

determine the level of confidence students felt during different critical thinking scenarios. This survey was developed using guidelines from Byrd and Van Gemert (2019). The survey contained eleven questions with a five-tiered ranking system for students to self-evaluate their confidence levels: never, rarely, sometimes, often, and always. The first time the survey was given as a pre-assessment to get a baseline for the group, next came a mid-assessment after students learned the eleven types of critical thinking but before the guided practice portion, and the final time was as a post-assessment after all the work and learning had occurred.

Figure 1 shows that student confidence levels in their ability to use various critical thinking skills changed drastically throughout the research window. Student confidence levels were increased across all five tiers, never through always, from the beginning to the end of the intervention. Their confidence levels grew beyond the never level after the intervention and only a few students responded in the rarely tier.

Figure 1:

Student Confidence Levels in Critical Thinking Scenarios



Note. This is the data from eighteen students who were asked the same eleven questions during

three different times within the research window.

The second data tool utilized in this research was a survey asking students to determine which type of the eleven critical thinking skills would be needed to answer a specific question (see Appendix F). This survey had six questions and was also delivered three times within the research window: before, during, and after intervention. For each question, students chose which types of critical thinking skills were needed from the following list: across disciplines, big idea, details, ethics, language of the discipline, multiple perspectives, over time (change), patterns, rules, trends, and unanswered questions.

Figure 2 shows that students' understanding of the different critical thinking skills varied by skill. By the end of the intervention students were able to be more focused on what types of thinking were needed in each question. Figure 2 shows the wide range of answers around utilizing the information learned from other content areas. By the end of the intervention students were able to identify when these four strategies applied to the learning from other content areas: Across Disciplines (34%), Details (17%), Multiple Perspectives (34%), and Patterns (14%) of thinking help students. The survey shows students did not know when to use three of the strategies: Ethics (0%), Language of the Discipline (0%), and Trends (0%).

Figure 2

Student Responses for Question One of Critical Thinking Survey (see Appendix F).

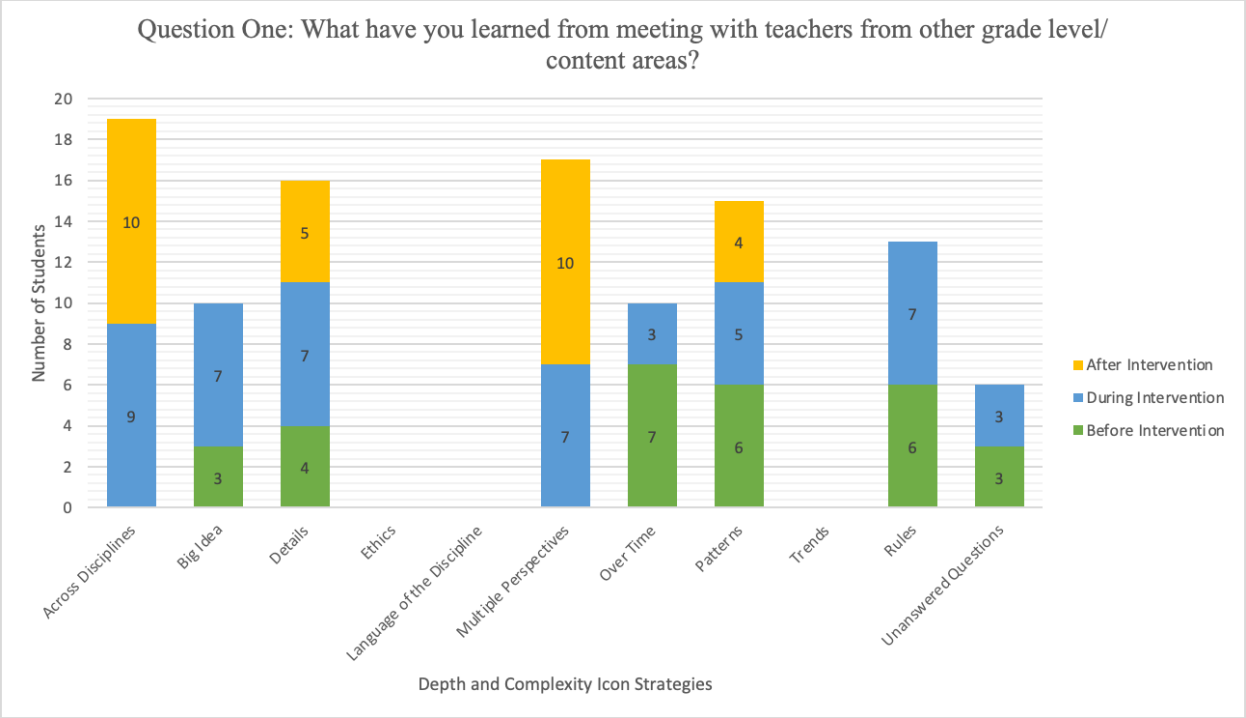
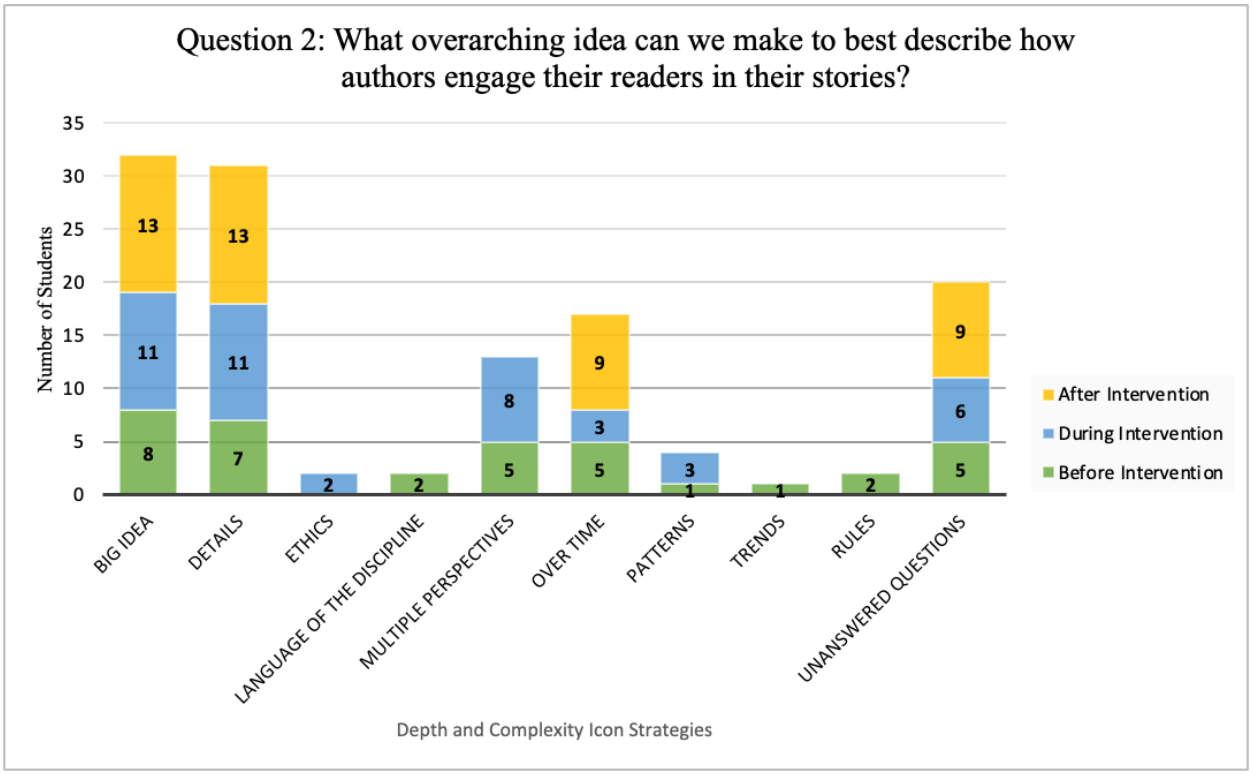


Figure 3 showcases that students' understanding of theme and main idea concepts in reading are connected with Big Ideas (30%), Details (30%), Over Time (Change)(20%), and Unanswered Questions (20%). The data from the Before and During Intervention surveys shows that students did not have a strong understanding of what kind of thinking was needed to answer the question but that shifted and solidified in the After Intervention survey. The strategies of Across Disciplines and Multiple Perspectives are the strategies that would be expected as answers to this question.

Figure 3

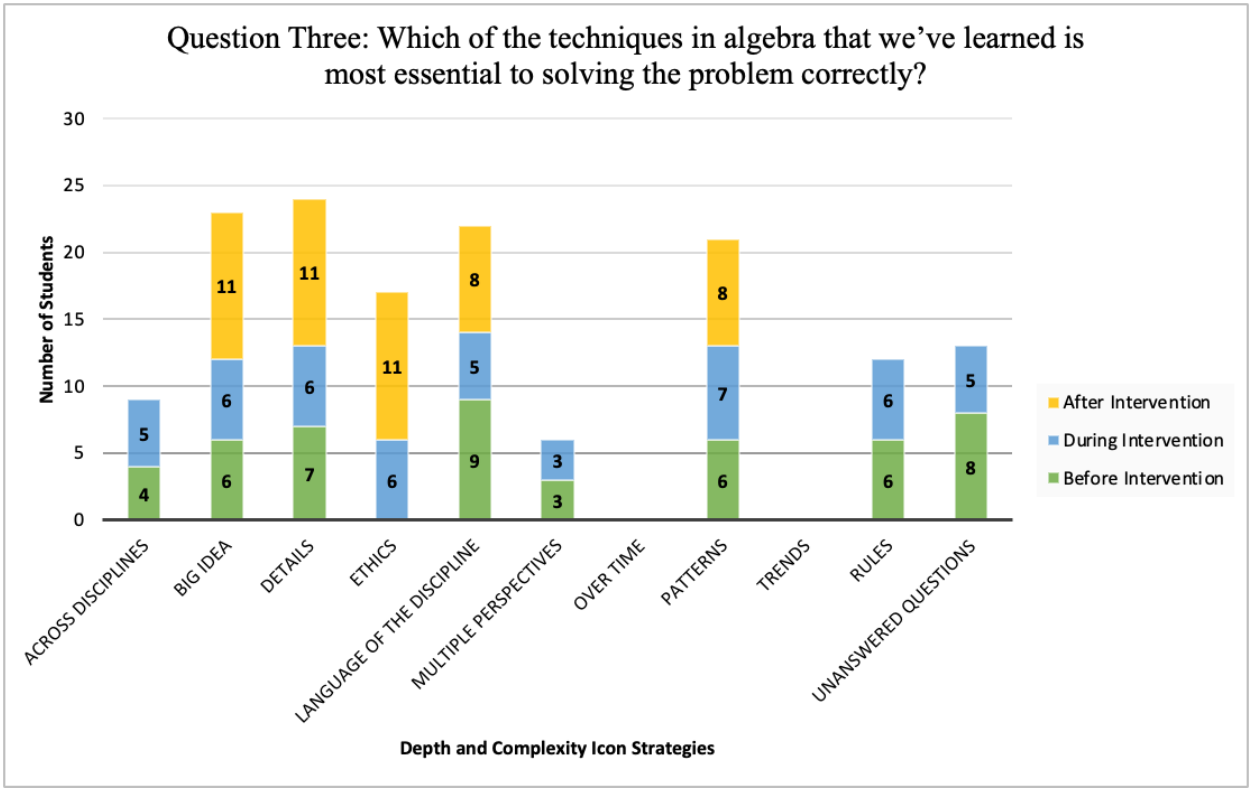
Student Responses for Question Two of Critical Thinking Survey (see Appendix F).



In Figure 4 when asked which strategy would actually apply to algebraic thinking, student answers were spread across the skills and many of the students identified ethical thinking. In reality, Big Ideas, Details, Language of the Discipline, and Patterns are the strategies that would be best to use to answer this question. Students did choose Big Idea (22%) and Details (22%), a total of eleven times each, in the After Intervention survey, which places those strategies as the highest chosen along with Ethics.

Figure 4

Student Responses for Question Three of Critical Thinking Survey (see Appendix F).



The information shown in Figure 5 details how students have a solid grasp on the strategies of Big Idea (21%) , Details (27%), Over Time (Change) (27%), and Patterns (14%). The changes between the Before Intervention survey and the After Intervention survey show that students focused more on the words "life cycle" than on the idea of how an expert in the field would use language to describe those changes. The students may have been thinking deeper than the idea of vocabulary and that is why they chose the other strategies over the language of the discipline.

Figure 5

Student Responses for Question Four of Critical Thinking Survey (see Appendix F).

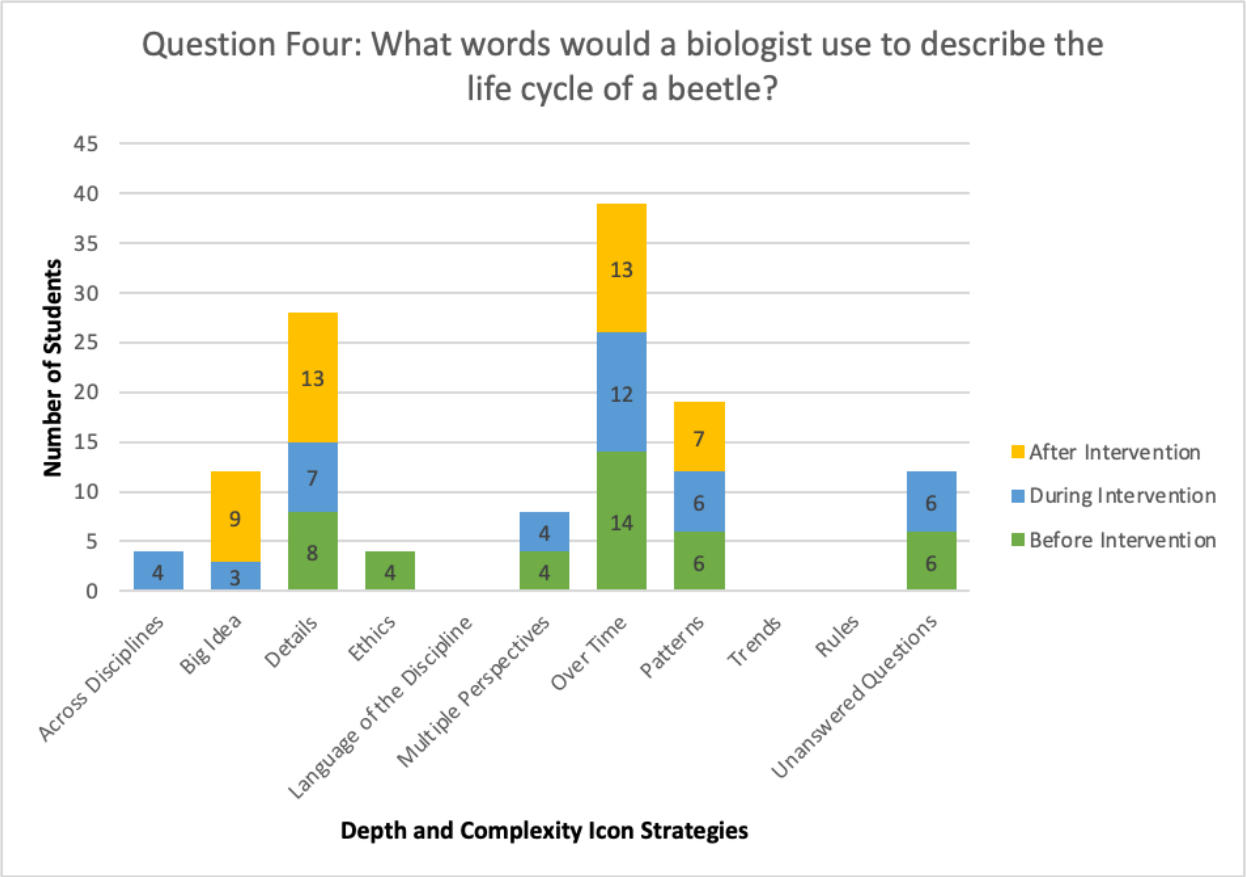
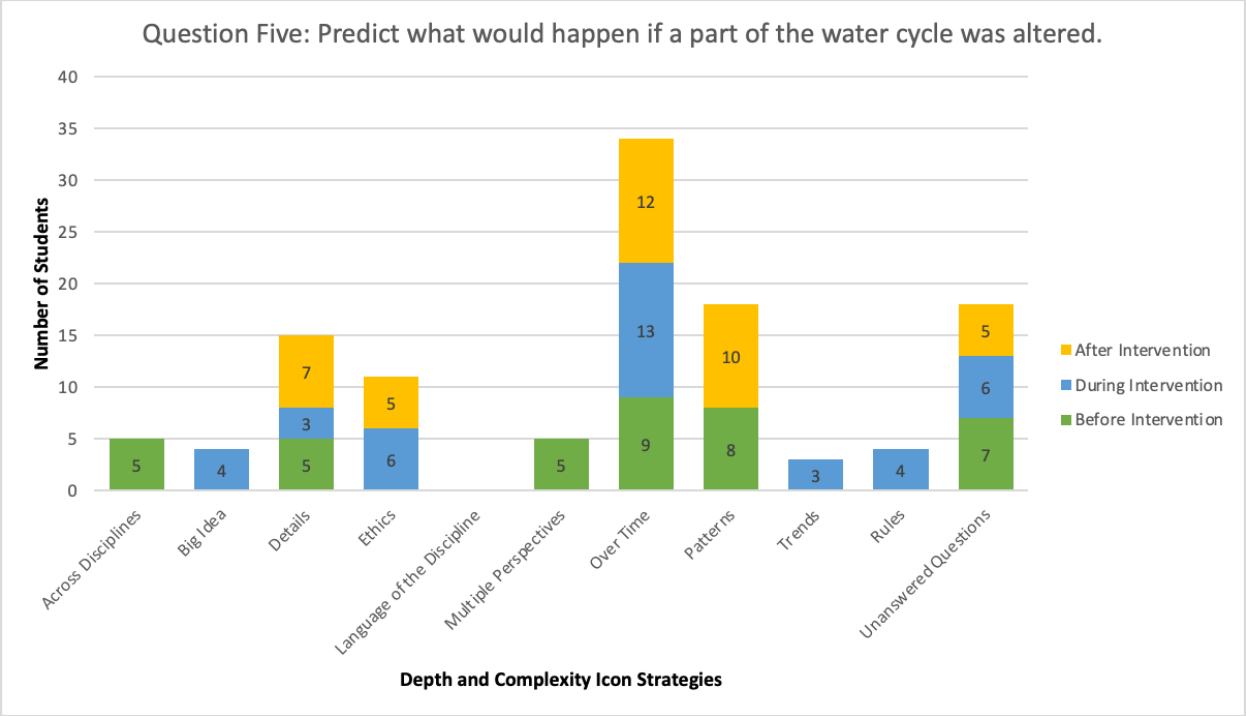


Figure 6 shows that students understand that there are many parts and ideas connected to predictions and that they need to utilize their background knowledge and understanding in order to make predictions. Students' choices changed over time from the Before Intervention survey to the After Intervention survey, by the end of the intervention the students settled in on Patterns (26%) and Over Time (Change) (31%).

Figure 6

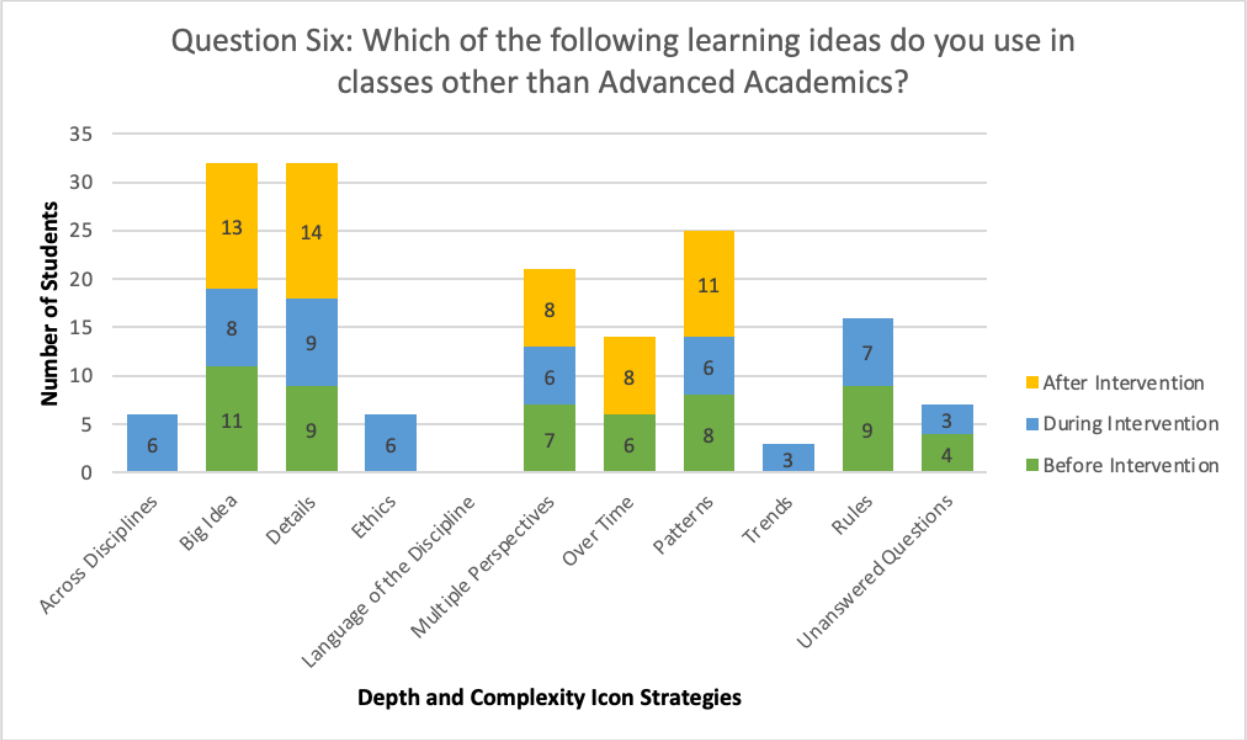
Student Responses for Question Five of Critical Thinking Survey (see Appendix F).



The information in Figure 7 connects with how students apply the skills they have learned throughout the critical thinking process from the Advanced Academics classes into their regular classroom. These skills include Big Idea, Details, Multiple Perspectives, Over Time (Change), and Patterns. This shows a growth in all four strategies throughout the intervention process. Big Idea started at 20% of responses and then grew to 24% of the responses. Details grew from 17% of responses to 26% of responses. Multiple Perspectives grew from 13% to 15%. The strategy of Over Time (change) grew from 11% to 15% after the intervention. And finally, the strategy of Patterns grew from 15% to 20% after the intervention.

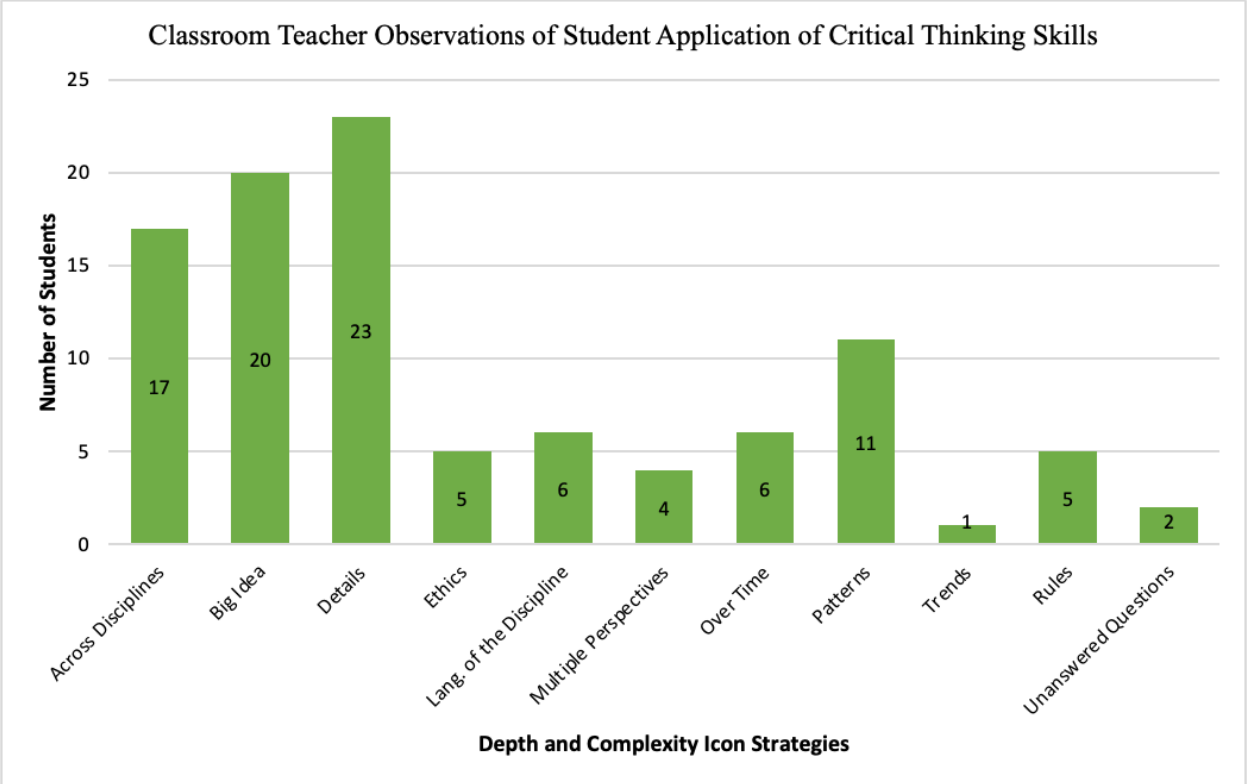
Figure 7

Student Responses for Question Six of Critical Thinking Survey (see Appendix F).



The third and final data collection tool was a teacher observation form that classroom teachers kept track of in their own rooms, separate from the researcher. These forms collected how often students either drew one of the Depth and Complexity icons or if they mentioned the type of critical thinking they were doing in that activity. Teachers were asked to complete this section after the modeling and guided practice portion of the unit was completed (see Appendix B). The results, shown in Figure 8, show that students felt they were using Across Disciplines (17%), Big Idea (20%), and Details (23%) the most often in their regular classrooms. This also shows their confidence levels seem to be higher in those three areas than in others like Trends (1%) and Unanswered Questions (2%).

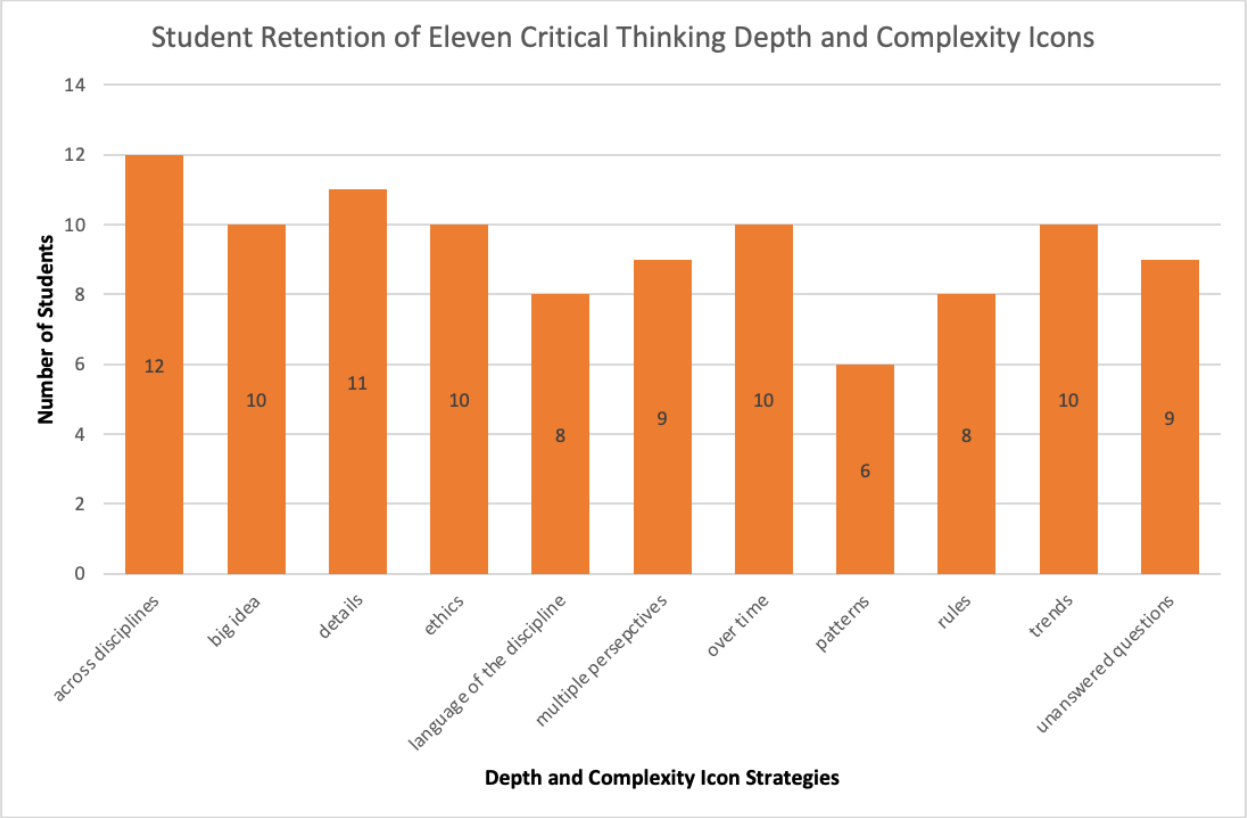
Figure 8



Note. Grade level classroom teachers kept track of how often their students either wrote the icon for a specific type of critical thinking or if a student mentioned and labeled that thinking out loud. This data was collected in three third grade classrooms over the course of the intervention.

Figure 9 shows student retention rates from six weeks after the intervention was completed. The majority of students were able to recall these 6 strategies: across disciplines, big idea, details, ethics, over time (change), and trends. Twelve students participated in this reflection and it took place during the week of 6 weeks after the intervention ended.

Figure 9



Note: Twelve of the eighteen students were asked to name as many of the DCI as they could remember six weeks after the intervention was completed.

This study examined the impact of explicitly teaching the eleven critical thinking skills and the DCI through teacher modeling, guided practice, and independent practice. Student confidence levels in their identification of critical thinking skills rose throughout the intervention as well as their ability to apply those same critical thinking skills in both the Enrichment classroom and their own regular classroom.

Conclusions and Recommendations

The purpose of this action research was to determine if teaching elementary students critical thinking skills through the use of modeling, guided practice, and independent activities would increase their ability to apply critical thinking skills within the context of other school

based activities. Data collection tools included surveys and teacher observations within the Advanced Academics class as well as the regular education classroom. After analyzing the data produced by this study it has been determined that, through the use of explicit teaching, students are not only capable of identifying when they apply what they learned to other activities but that they also became more confident in identifying those skills.

The baseline data showed that, as a whole group, the students had a wide range of confidence levels ranging from non-existent to always understanding the types of critical thinking that can be done in their learning. By the end of the intervention, students' confidence levels had risen significantly, signifying that by teaching each skill on its own and then combining all the skills together led students to a greater understanding and confidence in their own ability to utilize and access critical thinking skills on their own. These results show that incorporating the DCI into the lessons of my classroom had and will continue to have a direct and positive impact on student understanding of critical thinking skills and strategies.

The data in Figure 2 shows that students grew ~~extensively~~ in their understanding of the strategies because none of them had identified Across Disciplines or Multiple Perspectives in the before intervention survey but by the after intervention survey, those two strategies were the most identified.

Moving forward the research from this paper lends support for continuing the practices of: implementing discussions about the DCI, keeping visuals of each DCI around my classroom, asking students to determine which skills are needed in different situations, and keeping projects and discussions open-ended. The observational notes showed the importance of open-ended projects and discussions because students were applying critical thinking skills within the context of those projects and discussions. As students worked through their projects and the classroom

teachers facilitated that learning, the application of critical thinking skills became evident in the vocabulary the students were using. The students would label when they were utilizing the strategies of across disciplines (17%), big ideas (20%), and details (23%) both verbally and written communication. Intentionally implementing the visuals of the DCI for reference throughout class discussions will also help students connect to their critical thinking skills. Once students have learned the eleven types of critical thinking skills, the majority of the school year will be spent applying the skills and discussing with each other how to best apply the skills. This will support students to take ownership of their learning and strengthen their own understanding throughout the school year.

Critical thinking skills have been hard to quantify for many teachers but the research in this paper shows that utilizing the DCI within the classroom is both an approachable way to integrate critical thinking skills but also something that will help students build their confidence. Through the use of student surveys and teacher observations that looked for specific types of critical thinking skills this research was able to quantify the improvement in both student confidence levels and student ability to apply critical thinking skills.

Another positive impact of this research is the findings may encourage teachers to grow in their own confidence of teaching critical thinking skills through the use of the DCI. This research shows that students who learn concrete examples and have visual/non verbal reminders of the types of critical thinking skills are more confident in their application of said skills. When students are confident in their learning, teachers naturally are as well.

I would like to study the impact of creating a safe and brave space for students to utilize their critical thinking skills within an environment full of new learning and concept building. Florea and Hurjui (2015) share that creating a safe space for students to try out new concepts and

take risks in their learning will have a positive impact on student learning. I am interested to understand how my students define a safe, brave space so that I can examine my classroom using their criteria.

There is not much research on how visual aids such as the Depth and Complexity Icons by Bette Gould and Sandra Kaplan might impact how students utilize their critical thinking skills. More research needs to be done to see how visual aids might impact students' understanding of when to use specific critical thinking skills. There is potential for further research by following students from this research over the course of the next two school years to see how well they are able to apply these skills outside of the specific lessons taught in the Advanced Academics classroom.

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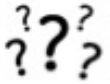
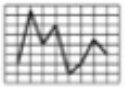
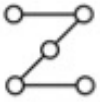
Appendix A

Depth & Complexity	Icon	Definition or Key Words	Example
Ethics		Morals, Right vs. Wrong, Values or Judgments, Pros and Cons	
Big Idea		Overarching Idea, Theme or Generalizations, Whole	
Detail		Evidence, Description, Characteristics, Parts	
Unanswered Questions		Unknown or Unexplained, Uncertain, Dilemma	
Rules		Classify, Organize, Structure, Methods or Procedure	
Trends		Tendencies, Style, Influence	
Language of the Discipline		Speech, Terminology, Vocabulary	
Patterns		Repetitive, Cycle, Predict, Recurring	
Changes Over Time		Past, Present, Future, Change, Connections Across Time	
Across Disciplines		Multidisciplinary, Across Different Subjects, Connections	
Multiple Perspectives		Different Points of View, Different Ways of Seeing Things, Affected by Roles	

Appendix B

Type of Thinking	Description	Tallies	Dates
Across Disciplines	How does this topic represent an intersection of other fields? Also, consider how the topics cross within one discipline.		
Big Idea	An overarching statement about a topic. Moves students towards abstraction and away from specifics.		
Change Over Time	Takes students broader, asking them to consider how a topic has changed (or not changed) as time has passed.		
Details	The most important specifics about a topic. Moves students away from abstraction and towards evidence.		
Ethics	The problems, ambiguities, or dilemmas of a topic. Students should be considering pros and cons, resolving issues of fairness, or pondering “What is right?”		
Language of the Discipline	The vocabulary an expert would use to discuss their field.		
Patterns	Things we expect to repeat within a topic. A pattern can break without necessarily creating a problem.		
Multiple Perspective	Takes students broader, asking them to consider the same topic from different points of view including specific people, groups of people, plants or animals, or even inanimate objects.		
Rules	The laws, hierarchies, norms, etc within a topic. These are things that we expect to be followed. Rules can be broken, but it will lead to consequences.		
Trends	How is a topic currently changing and what forces are causing those changes?		
Unanswered Questions	The things about a topic which we currently do not know enough about or, possibly, cannot know about.		

Anecdotal Notes

Appendix C

Directions: Draw the symbol for each Depth and Complexity Icon on the card, then cut out the cards and write a brief definition for each type on the back of the card.

Across Disciplines	Big Idea	Details
Ethics	Language of the Discipline	Multiple Perspectives
Over Time	Patterns	Rules
Trends	Unanswered Questions	

Appendix D

Student Flashcards: Depth and Complexity Icons				
Criteria	3 pts	2 pts	1 pt	
Writing is neat and legible				/3
Definition is concise and easy to understand				/3
Icon is clear and easy to read.				/3
				Total Points: _____

Appendix E

Critical Thinking Confidence Survey

Rank each type of thinking and your amount of confidence in using that type of thinking.

Name: _____

I can explain the big idea or concept of a lesson.

1 2 3 4 5

I don't know what this is — I feel that I can use this in my regular classroom

---

I can explain how a concept will change over time.

1 2 3 4 5

I don't know what this is — I feel that I can use this in my regular classroom

---

I can explain the parts of a concept using detailed descriptions.

1 2 3 4 5

I don't know what this is — I feel that I can use this in my regular classroom

---

The idea of ethical thinking is important to me.

1 2 3 4 5

I don't know what this is — I feel that I can use this this in my regular classroom

---

When I learn the vocabulary of a topic, I can use it correctly.

1 2 3 4 5

I don't know what this is — I feel that I can use this this in my regular classroom

---

I find patterns in the concepts I learn in my regular classroom.

1 2 3 4 5

I don't know what this is — I feel that I can use this this in my regular classroom

---

I listen for other people's perspectives when in small group discussions.

1 2 3 4 5

I don't know — I feel that I can use this

what this is this in my regular classroom

I look for rules or guidelines that don't make sense to me.

1 2 3 4 5

I don't know I feel that I can use this
what this is this in my regular classroom

I can explain how ideas connect over the course of a unit of study.

1 2 3 4 5

I don't know I feel that I can use this
what this is this in my regular classroom

I look to answer the questions I have during a unit of study. I ask and search until I find those answers.

1 2 3 4 5

I don't know I feel that I can use this
what this is this in my regular classroom

Appendix F

Critical Thinking Skills Application Survey

For each question, choose the type of critical thinking skill or skills you will need to use in order to solve the problem. Check all that apply for each problem, question, or situation.

Name: _____

What have you learned from meeting with teachers from other grade level/ content areas?

- ☐ Across Disciplines
- ☐ Big Idea
- ☐ Details
- ☐ Ethics
- ☐ Language of the Discipline
- ☐ Multiple Perspectives
- ☐ Over Time (change)
- ☐ Patterns
- ☐ Rules
- ☐ Trends
- ☐ Unanswered Questions

What overarching idea can we make to best describe how authors engage their readers in their stories?

- ☐ Across Disciplines
- ☐ Big Idea
- ☐ Details
- ☐ Ethics
- ☐ Language of the Discipline
- ☐ Multiple Perspectives
- ☐ Over Time (change)
- ☐ Patterns
- ☐ Rules
- ☐ Trends
- ☐ Unanswered Questions

Which of the techniques in algebra that we've learned is most essential to solving the problem correctly?

- ☐ Across Disciplines
- ☐ Big Idea
- ☐ Details
- ☐ Ethics
- ☐ Language of the Discipline
- ☐ Multiple Perspectives
- ☐ Over Time (change)
- ☐ Patterns
- ☐ Rules
- ☐ Trends
- ☐ Unanswered Questions

What words would a biologist use to describe the life cycle of a beetle?

- ☐ Across Disciplines
- ☐ Big Idea
- ☐ Details
- ☐ Ethics
- ☐ Language of the Discipline
- ☐ Multiple Perspectives
- ☐ Over Time (change)
- ☐ Patterns
- ☐ Rules
- ☐ Trends
- ☐ Unanswered Questions

Predict what would happen if a part of the water cycle was altered.

- ☐ Across Disciplines
- ☐ Big Idea
- ☐ Details
- ☐ Ethics
- ☐ Language of the Discipline
- ☐ Multiple Perspectives
- ☐ Over Time (change)
- ☐ Patterns
- ☐ Rules
- ☐ Trends
- ☐ Unanswered Questions

Which of the following learning ideas do you use in classes other than Advanced Academics?

- ☐ Across Disciplines
- ☐ Big Idea
- ☐ Details
- ☐ Ethics
- ☐ Language of the Discipline
- ☐ Multiple Perspectives
- ☐ Over Time (change)
- ☐ Patterns
- ☐ Rules
- ☐ Trends
- ☐ Unanswered Questions