2016

Critical Thinking in the Classroom: A Problem Based Learning Approach

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CRITICAL THINKING IN THE CLASSROOM:
A PROBLEM BASED LEARNING APPROACH

By
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A Thesis submitted to the
Department of Communication Science and Disorders
in partial fulfillment of the requirements for graduation with
Honors in the Major

Degree Awarded:
Spring, 2016
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Critical Thinking and Problem Based Learning

What does it mean to be a good critical thinker? There are many different definitions of critical thinking but most writers generally agree that a good critical thinker possesses certain skills. These skills include: analysis, evaluation and self-regulation, the ability to distinguish relevant from irrelevant information, and pose questions whose answers will help to broaden one's understanding of an issue (Yang et al., 2008; Uba, 2008). Although there is still much debate over the best way to improve students’ critical thinking skills in the university classroom, one point is universally agreed upon: the teaching of critical thinking and honing of the associated skills and dispositions is paramount to a student’s continued success within and beyond the classroom (Semerci, 2005; Uba, 2008; Yang et al., 2008). This paper will include discussion of the findings of several scholarly works on critical thinking, problem-based learning, learning-oriented assessment and how to best implement these practices within the university setting. The limitations of problem based learning (PBL) implementation in the classroom will also be explored. The purpose of this study is to determine the effectiveness of PBL pedagogical techniques within the university classroom for developing critical thinking skills.

Critical Thinking Skills vs. Critical Thinking Disposition

Several authors on critical thinking highlight a contrast between critical thinking skills and critical thinking disposition or attitude (Butchart et al., 2009; Uba, 2008; Yang et al., 2008). Though many authors merely gloss over the concept of the critical thinking disposition (CTD) and assume the reader is familiar with the associated attributes, they all state the need for more research in this particular area of critical thinking (Butchart et al., 2009; Ribeiro, 2011; Semerci, 2005; Uba, 2008). However, Yang et al. (2008)
provide an excellent description of the attributes associated with CTD, describing it as encompassing the motivation and habits of the mind to think critically, self-confidence, and a willingness to suspend judgment and remain open minded. In contrast, critical thinking skills (CTS) as previously stated include self-regulation, analysis, evaluation, and cognitive skills or abilities (Yang et al. 2008). However, Yang et al. (2008) state that being disposed towards critical thinking does not assure that one has CTS, and being skilled does not assure one is disposed to use critical thinking. These authors reported a positive correlation between CTS and CTD. These results agreed with earlier findings by Facione et al (1994), which showed students with high CTS tend to have high CTD. From these results Yang et al (2008) concluded that the best way to help students reach their full CTS potential is to teach using CTS instruction with CTD cultivation. CTD cultivation within the classroom focuses on five main principles: (1) cultivate a culture of reasoned thinking and evidence-based inquiry; (2) provide models of good thinking behavior; (3) provide opportunities for peer interaction around thinking; (4) evaluation of processes, not results only; and (5) expect and reward virtue. Each of these principles directly corresponds with a problem-based learning environment and is thought to provide the most supportive learning environment for students to become actively engaged with the content as well as their peers.

In addition to cultivating the critical thinking disposition there are three types of knowledge within the critical thinking classroom that aid in the construction of new knowledge. Conceptual, procedural, and attitudinal knowledge are three types of knowledge as discussed by Luis Ribeiro (2011) that “promote the acquisition of an increasing body of technical and scientific knowledge while fostering development of
other types of knowledge… without overburdening the curricula or extending the period of formal training”(1). While Yang et al. (2008) speak only to CTD cultivation within the classroom, Ribeiro (2011) discusses the implementation of CTD and CTS through instructional approaches centered on the three main types of knowledge. Conceptual knowledge can be correlated to content or curriculum knowledge held by the learner, while procedural knowledge can be correlated to critical thinking skills and attitudinal knowledge to the critical thinking disposition of the learner.

*Problem Based Learning as a Method of Implementation*

There are several different strategies of critical thinking and problem-based learning assessment and implementation discussed within the literature. It is widely agreed that a “pure” problem-based learning (PBL) approach is the most difficult for students and teachers alike, the reasons for which will be discussed later in this paper (Kwan, 2008; Mitchell, 2010; Williamson et al. 2010). However there are many modified PBL approaches that have been found to be as effective as a “pure” PBL approach while also being more approachable to those students who have had no experience with PBL or are lacking critical thinking skills. Kwan (2008) explored two common variations of PBL in addition to the pure PBL model in her study. Pure PBL is a student centered pedagogical approach, which focuses on solving open-ended problems using previous knowledge to construct new knowledge, and encourages collaborative learning as well (Kwan, 2008). The second mode used in Kwan’s study was an alternate mode of PBL, which included feedback from a tutor on work and teacher-led deductive workshops, while the third PBL mode included hands on practice for the students with scaffolding implemented within the curriculum and the teacher performing only a supervisory role
At the end of Kwan’s study the participants were required to rate each PBL mode in relation to three characteristics: enhancing knowledge construction, establishing professionalism, and training pedagogical skills (Kwan, 2008). None of the respondents chose mode 2 for enhancing knowledge construction, while the student-teachers found modes 1 and 3 equally useful regarding the enhancement of knowledge construction. Mode 1 was the preferred mode regarding the establishment of professionalism, while mode 3 was preferred for the enhancement of pedagogical skills (Kwan, 2008).

In addition to the problem-based learning approaches for teaching critical thinking there are also formative and summative assessment approaches. Summative assessments, which are more common in the lecture based university classroom include traditional exams, papers, and final projects and focus on evaluating student learning at an educational benchmark. Formative assessments unlike summative assessments focus more on the learning process than the actual measurement aspect and include concept mapping, and learning-oriented assessment (Lombard, 2008). Lombard’s study strives to show the importance of “the alignment of instruction, learning and assessment” through the use of learning-oriented assessment (LOA) (Lombard, 2008, 1038). Carless (2007) stated that LOA is based upon three key elements: (1) designing assessment tasks to promote learning and stimulate learning dispositions (2) stimulating learner involvement by means of assessment tasks (3) supporting current and future learning though prompt feedback (59). Through these three key points LOA can be seen as “the alignment of instruction, learning and assessment” (Lombard 2008, 1038). It should be noted that Lombard stated that LOA is an insufficient instruction method for developing sustained
critical thinking skills in students; however it is an important aspect of the critical thinking classroom and instrumental in changing the thinking patterns of students (Lombard, 2008). Concept mapping is also a type of formative assessment used to improve critical thinking skills. In a single semester study conducted by Butchart et al. (2009) evaluating critical thinking skills participants were required to practice extensively with an automated feedback argument mapping software. The results of this study were an improvement in critical thinking skills by 0.45 standard deviations from pre to post-test (Butchart et al. 2009). They reported a significant gain in critical thinking skills in comparison with other research reports of student improvement of 0.1 standard deviations over the course of a semester with no explicit critical thinking instruction (Van Gelder, 2007).

Traditional lecture style teaching has “sometimes been shown to stymie creative thinking and problem solving” with students depending on the instructor to feed them the information they need to be successful in the class (Reynolds et al 2010; Lombard 2008). While a teacher-centered approach such as lecturing may hinder creative and critical thinking, a student-centered approach such as PBL has been shown to improve critical thinking skills and dispositions (Semerci, 2005). Critical thinking skills are highly valued not only in the university system but also in the workforce. As such the improvement of these skills and dispositions through critical thinking instruction is not only beneficial to the student today but well into the future in their chosen career field (Casotti et al., 2008). The improvement of critical thinking skills and dispositions helps the learner to become more self-confident, open-minded, motivated, and establishes good communication through teamwork while providing higher-order thinking and decision making skills
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(Semerci, 2005; Yang et al., 2008). Additionally, PBL can “help to strengthen a positive professional attitude by pursuing the ideal of life-long, self-directed and group-based collaborative learning” (Kwan, 2008, 340-341). As the depth and breadth of knowledge is constantly expanding in scientific fields of study, including speech-language pathology, life-long, self-directed learning is a necessary facet of science-based professions.

However, teaching critical thinking using problem-based learning is not an educational cure-all as there are several negative aspects associated with it for teachers and students alike. The first problem listed is the amount of time required of both teacher and student to make this learning endeavor successful (Kwan, 2008; Casotti et al., 2008). For the student to be successful through PBL, extensive practice is required on carefully crafted problems and case studies (Butchart et al., 2009). For extensive practice to take place, the instructor must first put in the time required to carefully craft the necessary problems. Additionally, the workload of both teacher and student often increases with the implementation of a critical thinking course, as Casotti et al. (2008) state “Inquiry-based curricula are challenging to write, maintain, and coordinate”. Due to the difficulties in maintaining and coordinating the curriculum it is important according to Cassoti et al. (2008) for instructors to be flexible in their plans. Flexibility in teaching plans is fundamental to the success of PBL and critical thinking courses since learning through these strategies takes place through an active inquiry process. Allowing ample time for students to interact with the material, collaborate with peers and ask questions in the learning environment is paramount to the problem-based learning process and enhancement of critical thinking skills (Kwan, 2008; Mitchell et al., 2010; Ribiero, 2011). Interaction with the material through activation of prior knowledge to create new
knowledge or peer collaboration is where learning happens within the PBL/critical thinking spectrum. Because interaction is integral to the success of the critical thinking process it is essential for the student to be actively engaged with the material as well as the learning environment.

One factor which often hinders the critical thinking learning process is a lack of confidence in problem solving (Mitchell et al., 2010; Reynolds et al., 2010; Semerci, 2005; Williamson et al., 2010). In the beginning stages of PBL students often feel that they are “not always knowledgeable enough to solve problems” (Reynolds et al., 2010). This thinking will prevent students from exploring possible answers, and will sometimes lead to disengagement from the material (Reynolds et al., 2010). Scaffolding, modeling, instructor guidance and feedback are important aspects of any PBL and critical thinking curriculum to prevent learner disengagement (Butchart et al., 2009). Instructional scaffolding is defined as a learning process designed to promote deeper level learning and is a student tailored support system intended to help a student achieve their learning goals. Scaffolding is a collaborative process that allows for students to perform beyond the level they have cognitively attained on their own, but will soon attain and helps to move learning forward (Lombard, 2008). Scaffolding helps to ensure that the student will make few mistakes and will perform on the level of the other students within the group. Modeling, instructor guidance, and feedback each help to boost learner confidence by providing direction for the students while still allowing them to engage with the material and explore the learning process (Butchart et al., 2009).
Purpose

There is a general consensus among the literature that critical thinking skills are vital for student success, and that there is a fundamental lack in development of these skills throughout our educational system (Butchart et al., 2009, Lombard, 2008, Reynolds et al., 2010, Semerci, 2005, Yang et al. 2008). While researchers may implement different pedagogical techniques to improve critical thinking, it is agreed that student engagement with the material and learning process is of utmost importance. A significant amount of research on the teaching of critical thinking skills has been done within the health sciences field where hands on learning experiences abound (Casotti et al., 2008; Reynolds et al, 2010; Semerci, 2005; Svinicki, 2007).

There is a need for more research to be conducted regarding critical thinking implementation on a wider scale. University wide critical thinking curriculum implementation could be highly beneficial to students and teachers alike. With university wide implementation students would be exposed to critical thinking earlier in their studies and will develop higher order critical thinking skills by the time they enter their majors courses. The development of these skills earlier in their studies would allow for more in depth development of critical thinking skills and would also aid in the learning of course content, better preparing them for their careers where the knowledge will be translated. While much work and research has been done on critical thinking in the classroom, there is still much to be done as the literature overwhelmingly agreed (Butchart et al., 2009, Lombard, 2008, Reynolds et al., 2010, Semerci, 2005, Yang et al. 2008). Thus, critical thinking is a complex skill and concept that is difficult to teach, however the necessity and benefits of this skill within the university and the workplace
make it a skill that is worth teaching and learning. The purpose of this project is to measure the effectiveness of a PBL teaching approach in the development of critical thinking skill among communication science and disorders (CSD) undergraduate students. It is hypothesized that the CSD students in a PBL taught course will demonstrate significant improvements in critical thinking skills as demonstrated on a specific content critical thinking assessment, the Critical Thinking in Communication Sciences and Disorders (CTCSD), and a general critical thinking assessment, the Critical Thinking Assessment Test (CAT).

Methodology

Subjects

Thirty-one (1 male, 30 female) undergraduate students enrolled in a Communication Science and Disorders class, SPA 4101 Anatomy and Physiology of the Speech and Hearing Mechanism were the participants of this study. At the beginning of the semester they were informed of the nature of the study and were given an informed consent form, the study and the form were approved by the Florida State University Institutional Review Board. Two students exited the program before post-tests could be administered, so complete data is available for 29 participants (1 male and 28 female).

Procedures

The study was conducted during the students’ laboratory section, which was taught using an implicit PBL pedagogical approach. This study utilized a single group pre and post-treatment design. Baseline measurements of the students’ critical thinking skills were taken during the first week of class. Measurements were taken using a general critical thinking assessment, the CAT, and a content specific critical thinking assessment,
the CTCSD. These same assessments were repeated at the end of the semester to collect post-treatment data. Two 60-minute periods were allotted for completion of both critical thinking skills tests.

During the semester the students completed 10 class sessions of critical thinking instruction via a PBL pedagogical approach. This instruction began with background on what comprises critical thinking and common errors in thinking patterns. During the semester three units were presented with a communication disorders based clinical case study as the focus in each unit. The instructor presented the clinical case and gave the students time in class to discuss the vocabulary in the problem and the relevance of the information in the problem. Time was also given for open questions of any of the case study content. The participants then formed groups to discuss concept maps to address the problem. The participants then individually prepared a concept map to evaluate their thinking. The assessment of the maps included feedback on the thinking strategies evident on the maps. Once the maps were handed in to the instructor to be assessed, large group discussion of the problem and possible diagnoses was facilitated by the instructor. Participants were encouraged to share their diagnoses of the problem, how they arrived at that diagnosis, and what evidence from the case supports their diagnosis. Table A includes a list of the critical thinking skills targeted by each assessment item on the two skills assessments used in this study. Skills specifically targeted during the intervention by the instructor were the target skills associated with CAT items 3, 6, 9, 12, 14, and 15. The specific skills targeted by the instructor include: the provision of alternative explanations for a pattern of results that has many possible causes; provision of alternative explanations for spurious associations; provision of relevant alternative
interpretations for a specific set of results; explanation of how changes in a real-world problem situation might affect the solution; identification and explanation of the best solution for a real-world problems using relevant information; and the use of basic mathematical skills to help solve a real-world problem.

<table>
<thead>
<tr>
<th>CAT Item</th>
<th>CTCSD Item</th>
<th>Target Skill</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td>Summarize the pattern of results in a graph without making inappropriate inferences</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Evaluate how strongly correlational-type data supports a hypothesis</td>
</tr>
<tr>
<td>3</td>
<td>2, 12</td>
<td>Provide alternative explanations for a pattern of results that has many possible causes</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Identify additional information needed to evaluate a hypothesis</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>Evaluate whether spurious information strongly supports a hypothesis</td>
</tr>
<tr>
<td>6</td>
<td>9</td>
<td>Provide alternative explanations for spurious associations</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>Determine whether an invited inference is supported by specific information</td>
</tr>
<tr>
<td>9</td>
<td>3, 7</td>
<td>Provide relevant alternative interpretations for a specific set of results</td>
</tr>
<tr>
<td>10</td>
<td>14</td>
<td>Separate relevant from irrelevant information when solving a real-world problem</td>
</tr>
<tr>
<td>11</td>
<td>13</td>
<td>Use and apply relevant information to evaluate a problem</td>
</tr>
<tr>
<td>12</td>
<td>6a, 6b</td>
<td>Use basic mathematical skills to help solve a real-world problem</td>
</tr>
<tr>
<td>13</td>
<td>5</td>
<td>Identify suitable solutions for a real-world problem using relevant information</td>
</tr>
<tr>
<td>14</td>
<td>9</td>
<td>Identify and explain the best solution for a real-world problem using relevant information</td>
</tr>
<tr>
<td>15</td>
<td>15</td>
<td>Explain how changes in a real-world problem situation might affect the solution</td>
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</tbody>
</table>

Table A: Skills Targeted by each CAT and CTCSD Assessment Item

*Analysis*

Once the critical thinking pre and post-tests were completed, the participants’ responses were scored by the investigator and up to two assistants. Scoring of both evaluations had two people scoring each item. For a score to be counted, two scorers agreed on the answer rating. If agreement was not reached between the first two scorers, the third scorer read and scored the test item, with the students’ score always requiring
two scorers agreeing on the score for the item. To determine any changes in the students’ scores a repeated measure ANOVA was used. The items on the assessment served as a within subject variable and the testing times served as a between subject variable.

**Results**

The results of the CAT were not calculated in time to be included in the results of this study, thus results are from the CTCSD only. The results of a repeated measure ANOVA are shown in Figure B, with a comparison of pre and post-test means provided in Table B. Statistically significant score changes from pre- to post-test are highlighted. Only the target skills associated with CTCSD items 3, 9, 12, and 15 were targeted during the intervention, with the other target skills acting as control questions in the comparison of pre- and post-test data. Improvement in the targeted skill items was seen in the pre to post-test means, and the repeated measure ANOVA demonstrated that these changes were statistically significant. No statistically significant improvement was seen on the control questions (CTCSD Items 1, 2, 4, 5, 7, 8, 10, 11, 13, and 14). For the purpose of this study statistically significant improvement was defined as a mean difference greater than or equal to .50 between pre and post-test assessment scores. Comparison of pre and post-test means showed improvement of at least 0.03 on all assessment items except item 8, whose mean score declined to -0.03. The most statistical improvement was observed on CTCSD assessment items 9 (with a pre- to post-test difference of .55), 12 (with a pre to post test difference of 1.13) and 15 (with a pre- to post-test difference of 1.45). Target skills are noted for each assessment item in Table A with CTCSD items 9, 12 and 15 targeting the identification, evaluation and application of relevant information to solve a
real world problem, as well as the provision of alternative explanations for a pattern of results that has many possible causes.

![Figure A: Pre vs. Post Test Means of each CTCSD Assessment Item](image)

Table B: Comparison of Pre and Post Test Means

<table>
<thead>
<tr>
<th>CTCSD Item</th>
<th>Pre-Test Mean</th>
<th>Post-Test Mean</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.19</td>
<td>0.29</td>
<td>0.10</td>
</tr>
<tr>
<td>2</td>
<td>0.32</td>
<td>0.42</td>
<td>0.10</td>
</tr>
<tr>
<td>3</td>
<td>1.90</td>
<td>2.42</td>
<td>0.52</td>
</tr>
<tr>
<td>4</td>
<td>1.16</td>
<td>1.13</td>
<td>-0.03</td>
</tr>
<tr>
<td>5</td>
<td>0.48</td>
<td>0.52</td>
<td>0.03</td>
</tr>
<tr>
<td>6a</td>
<td>0.88</td>
<td>1.38</td>
<td>0.50</td>
</tr>
<tr>
<td>6b</td>
<td>0.87</td>
<td>1.39</td>
<td>0.52</td>
</tr>
<tr>
<td>7</td>
<td>2.84</td>
<td>3.10</td>
<td>0.26</td>
</tr>
<tr>
<td>8</td>
<td>0.74</td>
<td>0.71</td>
<td>-0.03</td>
</tr>
<tr>
<td>9</td>
<td>1.00</td>
<td>1.55</td>
<td>0.55</td>
</tr>
<tr>
<td>10</td>
<td>0.52</td>
<td>0.77</td>
<td>0.26</td>
</tr>
<tr>
<td>11</td>
<td>0.19</td>
<td>0.61</td>
<td>0.42</td>
</tr>
<tr>
<td>12</td>
<td>0.84</td>
<td>1.97</td>
<td>1.13</td>
</tr>
<tr>
<td>13</td>
<td>0.13</td>
<td>0.29</td>
<td>0.16</td>
</tr>
<tr>
<td>14</td>
<td>0.29</td>
<td>0.55</td>
<td>0.26</td>
</tr>
<tr>
<td>15</td>
<td>0.35</td>
<td>1.81</td>
<td>1.45</td>
</tr>
</tbody>
</table>

The statistical analyses indicated that the observed patterns achieved statistical significance. The Mauchly Test of Sphericity indicated that questions exhibited differing levels of variance among the questions ($W=.001$, $\chi^2(119)=201.062$, $p<.001$) and for the
interaction of the questions between the pre-test and post-test ($W=.001$, $\chi^2(119)=256.244$, $p<.001$). Therefore the Greenhouse-Geisser correction for the degrees of freedom was used in the repeated measure ANOVA.

The repeated measure ANOVA indicated that the students performed differently on the different questions ($F(7.654, 229.617)=35.987$, $p<.001$, $\eta^2_p=.545$). However, since the questions had different maximum scores, this result was expected. In addition, the students exhibited significant overall improvements in their post-test scores in relation to their pre-test ones ($F(1,30)=6.151$, $p=.019$, $\eta^2_p=.170$). Finally, they exhibited significant improvements on specific questions as shown by the questions by test interaction ($F(6.6570, 197.102)=27.374$, $p<.001$, $\eta^2_p=.477$). The effect sizes for both the main effects of questions and test time as well as the interaction effect were in the high range (Cohen, 1988). This finding indicates that all three of these effects explain a high proportion of the observed variability in the data.

Discussion

Our findings indicate that a ten week course utilizing a PBL pedagogical approach to critical thinking instruction can be effective in improving critical thinking skills. Our results are consistent with the findings of previous studies showing statistically significant improvement after a PBL intervention (Butchart et al., 2009, Casotti et al., 2008, Lombard, 2008, Reynolds et al., 2010). This implies that a PBL approach is a viable method of instruction for improving content specific critical thinking skills in students. Improvement was seen on assessment items with skills specifically targeted by the intervention (CTCSD items 3, 9, 12, and 15), as well as on items 6a, and 6b which were not specifically targeted. These skills were targeted during intervention by the
implementation of the PBL pedagogical approach and were facilitated by both large and small group discussion of the carefully crafted clinical case studies. Item 6 addressed the use of mathematical skill to solve a real world problem. It is thought that improvement on this assessment item occurred as a result of the emphasis placed on slowing down and attending to the thinking process throughout the intervention. Slowing down the thought process and actually taking time to think through a logical solution to the problem could have led to the increase in correct responses on items 6a and 6b.

Although there was statistically significant improvement in participant scores, other variables may have impacted the data of this study. This was not a controlled study, and as such the participants may have been influenced by outside factors such as other classes teaching related content. This particular effect may be seen in the improvement of test item 15 whose target skill was to explain how changes in a real world problem might affect the solution. Item 15 centered on hearing loss and amplification, and at the time of post-test administration the participants were enrolled in an introduction to audiology course. The students had also recently learned the fundamentals of acoustics and hearing just before taking the post-test, which may have informed their answers more than the critical thinking instruction. Additionally, some of the improvement in the results from pre to post test could be due to maturation of critical thinking skills over the course of the study regardless of the intervention. Scorer bias may have also been a factor, as the critical thinking skills instructors were also the scorers of the assessments. Efforts made to reduce scorer bias include the de-identification of participant assessments, adherence to a strict grading rubric, and requiring two-scorer agreement on each assessment item. Another factor influencing the improvement of later
assessment items could be that more students completed the post-test in its entirety compared to the pretest, thus raising the average score on those assessment items. Instructor quality and experience could also be a factor affecting the variables. The instructor of this course had previous experience with the PBL model and some critical thinking skills knowledge, but cannot be considered an expert in either. Additionally, this was the instructors’ first teaching experience and as such the actual teaching quality was not as high quality as that of a trained educational professional. However, pre-test post-test design flaw was avoided by administering the post-test after an extended break to reduce the participant’s memory of the test items and their previous answers.

While this study yielded promising results that were consistent with previous studies showing that short-term PBL instruction can improve critical thinking skills, a pure PBL model may not be the best pedagogical approach when teaching new content (Butchart et al., 2009, Casotti et al., 2008, Lombard, 2008, Reynolds et al., 2010). Participants in this study, like those in other successful PBL studies, often complained about the level of task difficulty and lack of confidence they felt when completing the concept maps (Butchart et al., 2009). As success was seen with the limited number of skills targeted during this intervention, but little improvement was seen on the untargeted yet related critical thinking skills, further research is required to determine if there is a finite amount of skills that can effectively be targeted during a short-term intervention period.

Continued research is also suggested to further explore the effectiveness of short-term critical thinking instruction in content specific courses. The exploration of more strategies to improve critical thinking, including the use of argument mapping software to
enhance problem based learning through increased practice, is also suggested as an area of further study. The exploration of the generalization of critical thinking skills across disciplines is also a suggested area of continued research. Critical thinking skills learned within a particular discipline, like those learned in this study within the realm of communication sciences and disorders, would also be helpful to the student in other areas of life. Finally, a longitudinal study examining how long critical thinking skill improvements are maintained is suggested so that we may begin to craft a pedagogical approach which encourages the long term development and maintenance of these vital skills.

Critical thinking skills are vital to the speech-language pathologist as they provide a quality thinking structure to assist in the diagnosis and initiation of a treatment plan through the identification and evaluation of relevant information. By improving these skills through targeted intervention we are honing the students’ ability to reevaluate their thought process and pieces of relevant information to come to a new diagnostic conclusion or treatment plan. The improvement of these skills will lead to clinicians who ascribe to best practices and are willing and able to work and re-work a complex clinical problem until the best solution is found for the patient.
References


