Critical Thinking, Transfer, and Student Satisfaction

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Abstract

A pedagogical treatment was developed to teach critical thinking knowledge, skills, and strategies to college students. This treatment was implemented at a Midwestern University for a three-year period. Graduates were surveyed to determine the extent to which the treatment affected their personal, academic, and professional lives. Graduates reported that they had transferred the critical thinking knowledge, skills, and strategies they had acquired, and were using it in their personal, academic, or professional lives. The graduates also reported that this transfer was extremely beneficial to them in all aspects of their personal, academic, or professional lives, leading to high levels of satisfaction in their undergraduate education.

Keywords: Critical Thinking, Transfer of Knowledge, Student Satisfaction, Graduate Satisfaction, Survey Assessment

Introduction

In 2011 at the International Symposium on Integrating Research, Education, and Problem Solving, we discussed a collaboration of research and teaching that led to a new course of study in critical thinking [1]. In that report, we established that workers in the 21st century would require critical thinking skills [2-4]. We also established that students were not receiving training in these skills [5-9]. Recently, two studies have emphasized the negative effects of the deficit in critical thinking skills among workers. Devore reported that employers expected that colleges of business administration had taught their graduates critical thinking skills. She reported that 87% of business school graduates had received no training in critical thinking skills [10]. This startling revelation was further amplified by a study produced by Woods-Bagot [11]. They reported that business managers and corporate-suite executives were singularly unimpressed with the skills acquired by business school graduates. Leading their list of unacquired skills was problem-solving and critical thinking, along with the inability to work with others.

The results of our study have been widely reported [12-16]. We developed a pedagogical treatment based on Halpern's Teaching for Critical Thinking model [17], using her book, Thought and Knowledge: An Introduction to Critical Thinking, as the primary textbook [18]. We reported that students who had undertaken this pedagogical treatment had improved significantly in six of seven parameters of the California Critical Thinking Skills Test [19].

In this paper, we report the results of a summative study of the students who took this course and have since graduated. The purpose of this study was three-fold. First, we wanted to determine quantitatively the extent the knowledge, skills, and strategies taught in the treatment were transferred into the personal, academic, and professional lives of the graduates. Second, we wanted to determine the effects of the treatment on the satisfaction of the graduates. Finally, we wanted to determine the feelings and sensibilities of graduates reflecting on the critical thinking treatment, its effects upon them, and their satisfaction in their undergraduate education.

It is widely recognized that self-assessments, including examinations, surveys or opinion polls, are characteristically flawed. Kruger and Dunning [20-23] have demonstrated that those in the lowest percentile on a variety of tests, consistently overestimate their knowledge, their abilities, and their scores. Those who score in the lowest quintiles consistently rate their performance in the upper third to lower fourth quintiles. Those who score in the top quintiles consistently rate their performance lower relative to other scores. However, once they know they are overestimating the capabilities of others and underestimating their own, they can determine their absolute scores with reasonable accuracy.

These miscalculations in both relative and absolute scores were related to the individual's metacognition of their actual abilities. By improving the participants' skills and their metacognitive awareness, they recognized their limitations and improved their ability to estimate their relative and absolute scores. Since one of the outcomes of the critical thinking pedagogical treatment for students is improved metacognition, then we would like to believe that the self-evaluations reported by the graduates in this survey is a close approximation of their actual status. However, since we cannot be sure, we sought confirmation.

Facione [24] conducted a Delphi study, in which 46 experts determined the cognitive skills, dispositional dimensions, and assessments that could be used to measure critical thinking. The results generated by this panel led to the development of the California Critical Thinking Skills Test, among others [19, 25]. In that Delphi study, the panelists agreed on four different methods that could be used to assess a person's critical thinking skills (emphasis added).

> In theory there are several ways persons can be judged to be more or less proficient in a given CT skill or at the integrated use of related CT skills.
>
> A third way is to query persons and receive their descriptions of the procedures and judgments they are using as they exercise that skill, would use if they were to perform that skill, or did use when they performed that skill. [24]

Other research has also shown that training in critical thinking, of which metacognition is a part, improves the capacities of persons responding to surveys such as ours. In 1999, Kruger and Dunning trained underachieving students to evaluate their own

performance, increasing their personal metacognition. These students improved their ability to differentiate their correct answers from their incorrect answers, concurrently improving their performance [20]. Subsequently, these authors demonstrated similar performance improvements using different tests and controls [23]. Finally, Helsdingen, Bosch, Gog, and Merriënboer reported that soldiers trained in critical thinking demonstrated improved command and control decision making, employing these skills in a variety of situations. They concluded that participants demonstrated deeper understanding of problems enabling them to solve new problems different from those in the training courses [26].

In our survey, we included a qualitative component with each of the specific questions. Further, our survey contained three additional questions requesting the graduates' opinions of the strengths, weaknesses, and potential modifications to the course. One use of these answers was strictly qualitative, i.e. to obtain new insights or explore alternate avenues. The second use of these answers was to determine the graduates' descriptions of the procedures and judgments they used as assessments of their acquisition and use of the knowledge, skills, and strategies taught in the critical thinking treatment. We have included such descriptions submitted by the graduates to confirm the transfer of critical thinking from the classroom into their personal, academic, and personal lives did occur, and to confirm the graduates' perceived levels of satisfaction with the pedagogical treatment and its affect on their satisfaction with the undergraduate education they received.

Method

Although one hundred sixty three persons were identified as having taken the critical thinking pedagogical treatment and had graduated with a bachelors degree from the college of business one to three years prior to this survey, valid contact information was obtained for 71 graduates. Of these, twenty-seven responded, a 38% return. These graduates became the population for this study.

A survey was developed to provide both quantitative and qualitative information concerning the pedagogical treatment. Two questions were used for screening purposes. Eleven questions were quantitative, based on a 7-point Likert scale. On this scale, 1 was the worst possible score, 7 the best possible score and 4 was defined as neutral. This scale was used to calculate the effects of transfer from the classroom into the lives of the graduates. This relationship is shown in Figure 1, Seven-Point Likert Scale.

Figure 1: Seven-point Likert Scale

1	2	3	4	5	6	7
Worst	Worse	Bad	Neutral	Good	Better	Best

These eleven questions also had a qualitative component, in which respondents were asked to provide their opinions on the subject posed by the question. In addition, three questions were qualitative, asking for the graduate's opinions on the best and worst parts of the critical thinking treatment, as well as any suggestions for changing, improving, or modifying the treatment.

The surveys were tabulated in a spreadsheet, and statistical analyses were performed to obtain the median and standard deviation. Cohen's d was calculated to determine the effect size. Since the mean of the survey question was defined by the Likert scale, a Z-test could be performed on the responses to determine quantitatively the transfer and use of critical thinking knowledge, skills, and strategies by graduates into their personal, educational, and professional lives.

To calculate the respondents' satisfaction, we applied the Likert scale. Using this scalar, we defined three parameters of satisfaction: Strength, Breadth, and Depth. We defined strength as the numerical difference between the mean score of the question and the neutral mean of the survey. We defined breadth of satisfaction as the ratio between the number of graduates with a positive satisfaction and those with a negative satisfaction. We defined depth of satisfaction as the ratio between the positive weighted values and the negative weighted values. The weighted values were calculated by multiplying the number of respondents that selecting a value by the value as shown in Likert scale. We developed an interval scale, which produced a consistent set of values that we could we could sum and average to produce an overall satisfaction score. We defined overall satisfaction score as the average of the strength, depth, and breadth scores.

Table 1.

Relationship of Scale Value to Strength, Breadth, Depth and Graduate Satisfaction Score.

Scale	**1**	**2**	**3**	**4**	**5**
Strength	<1	< 1.25	<1.5	<1.75	≥1.75
Breadth	<2	<4	<6	<10	≥10
Depth	<2	<4	<6	<10	≥10
GS	<1.9 Moderate	<2.9 Satisfied	<3.9 Very	<4.9 Extremely	≥5 Elated

For instance, a strength score of 1.4 would be assigned a scale value of 3. A breadth score of 3.5 would achieve a score of 2, while a depth score of 4.9 would rate a score of 3. The average of these scores is 2.7, which is a Graduate Satisfaction score of 2, designated as Satisfied.

Results and Discussion

Pre-Post Graduation Questions

We used four questions to explore the opinions of the graduates as student as different from their opinions as graduates. First, we asked the graduates about their opinion of the critical thinking treatment at the time they took the course as undergraduates. Their mean scores as students were 4.88 with a standard deviation of 1.45, a statistically significant result ($Z=3.03$, $p=.001$). Then, we asked the graduates their opinion of the treatment now that they have had the time and experience to reflect on the treatment. The mean scores for this question was 5.40 with a standard deviation of 1.61, which is significant, $Z=4.36$, $p=.00003$. The difference between the responses to these questions was not significantly different ($p=.055$), although this is sufficiently close to being significant to be considered closely.

The strength score for this question was +1.40. The breadth score was a ratio of 6 graduates satisfied for every one dissatisfied. The depth of satisfaction, as measured by the weighted scores, was even higher at 8:1. The Graduate Satisfaction score was 3, indicating that they were very satisfied.

In the second set of pre-post graduation questions, we asked the graduates about their perception of their need for instruction in critical thinking when they were students about to take the course. The mean score for this question was 4.68 with a

standard deviation of 1.72. This result was statistically significant, Z=1.97, p=.024. Then, we asked about their present opinion of their need for the critical thinking course. The mean score for this question was 5.55 with a standard deviation of 1.565. This result was statistically significant, Z=5.070, p<.00003. In this case, the means were significantly different, with p= .013. Therefore, we concluded with confidence, that the attitudes of graduates were significantly better towards the critical thinking component than were their attitudes as students at the time of the treatment.

We were also able to determine the degree of satisfaction of the graduates with this treatment. There strength score was +1.64. Their breadth ratio was 10.5 satisfied for every one dissatisfied, and the weighted depth ration was 11:1 in favor of the treatment. The Graduate Satisfaction score was 4, indicating that the graduates were extremely satisfied with the critical thinking treatment.

Typical graduate responses confirmed their use of critical thinking processes and procedures. Generally, these responses were in the form of an argument, in which premises supported a conclusion. On respondent wrote, "Everyone needs to learn critical thinking skills. Our younger generations have no clue of how to think for themselves. They don't know how to communicate.... How you respond when you are face to face with someone is critical. I'm currently going into Nursing; this field requires a person to use critical thinking." Another graduate put it this way, "I really needed to change the way I thought about life in general. This course helped change my life. I returned to school, finished my degree, and now currently working in the medical field that I tried to go into 20 years ago. My critical thinking skills have helped develop me into a wiser person." A third wrote, "The critical thinking course required much effort on my part. But, as I progress through the material, I realized how useful it was, and would make me a smarter decision maker." Finally, one wrote, "Before I took Dr. Anderson's critical thinking course, I was a firm believer that common sense was something that just could not be taught. After taking the course, I am a firm believer that it can be taught by using good old fashion logic and critical thinking." We interpreted these arguments as representative of, or congruent with the knowledge, skills, or strategies the graduates learned in the critical thinking treatment.

Educational Question

We asked the graduates to rate their use of the knowledge, skills, and strategies they had learning in the critical thinking treatment in their other academic pursuits. The mean score for this question was 5.22 with a standard deviation of 1.50, which is significant, Z=3.47, p=.0002. We deduced that the critical thinking treatment was extremely beneficial, otherwise the students would not be using it in other classes. We concluded, with an extremely high degree of confidence, that the students had used critical thinking in subsequent classes and that transfer had occurred.

We also calculated the degree of graduate satisfaction with the critical thinking treatment. We found the strength of satisfaction was +1.50; the breadth ratio was 3:1, while the depth ratio was 6.5:1. This was a notable result, because of the large difference between the breadth ratio and the depth ratio. In most questions, the two ratios are similar in size. In this question, however, the graduates with the negative scores were only slightly dissatisfied, while those with positive scores were enthusiastic in their assessment of their satisfaction with the effects of the critical thinking treatment. The Graduate Satisfaction was 3. We concluded that the graduates were very satisfied that the treatment was beneficial to their subsequent academic programs.

Again, we confirmed the graduates' critical thinking with their own words. One said, "I utilized this instruction through my two years at (university) and graduated Summa Cum Laude, with a 4.0 GPA." Another wrote, "I wish I could say every class required it, but one class that helped was Economics." A third opined, "One class that used some more thought to solve problems is Statistics." A fourth respondent wrote, "... any student can benefit from the critical thinking techniques found in this course. I recommend the instruction of critical thinking to all students wishing to become better decision makers." We interpreted these arguments, analogies, or statements as representative of or congruent with the knowledge, skills, or strategies the graduates learned in the critical thinking treatment.

Profession/Career Question

Another important question we asked of the graduates to evaluate their use of the knowledge, skills, and strategies they learned in the critical thinking treatment in their professions or careers. The mean score for this question was 5.24 with a standard deviation of 1.56, which is significant, Z=3.97, p=.00003. We deduced that the critical thinking treatment was extremely beneficial, otherwise the students would not be using it in their work. We concluded with an extremely high degree of confidence that the graduates transferred the critical thinking knowledge, skills, and strategies from the pedagogical treatment into their professions or careers.

The strength of the graduates' responses was calculated as 1.24. The depth ratio was 6 as was the depth ratio. Based on these scores, we conclude that the graduates were very satisfied that the knowledge, skills, and strategies they had acquired in the critical thinking pedagogical treatment were beneficial in their business or career.

We confirmed that graduates were using critical thinking from their own words. One said, "To my surprise forecasting and inventory control and things of that nature requires a lot of critical thinking skills." A second said, "It helps deciding many factors such as staffing needs, budgets, purchasing, and many more aspects of my job." A third stated, "Yes (I use CT at work), I sometimes have to do projections in our Fixed Asset System, and the software lets me do a trial and error approach to different 'what if' scenarios." A fourth respondent stated, "The best part of the critical thinking was being able to go through a process to solve problems that required more thought than just assuming the right answer." Again, we interpreted these arguments, analogies, or statements as representative of or congruent with the knowledge, skills, or strategies the graduates learned in the critical thinking treatment.

Personal Questions

In the next five questions, we asked how the critical thinking treatment had affected the graduates at a personal level. Three of the questions involved the graduate's interactions with others; two required their introspection to determine reasons for changes they observed in their interpersonal activities.

Personal 1: When we asked graduates if they used critical thinking in their daily lives, their responses were overwhelming in the affirmative. The mean score for this question was 5.80 with a standard deviation of 1.08. This result was statistically significant, Z=8.33, p<<.00001. This extraordinarily positive result indicates that the graduates were transferring the knowledge, skills, and strategies acquired in the classroom into their daily lives. Further, the fact that they are using these skills

is an extremely positive indicator of the need for such training. If these skills were not needed, the graduates would not be using them.

The graduates' strength of satisfaction was 1.80, the highest in the survey. The depth ratio was an extraordinary 23:1, while the breadth ratio was even higher, at 46:1. This is the second question, in which there was a large difference between the depth-scores and the breadth-scores in this question. One difference between this and the earlier question was that only one person expressed a negative satisfaction, and that level of dissatisfaction was minor. The other twenty-four respondents enthusiastically expressed very high levels of satisfaction, completely out of proportion to their numbers. Their Graduate Satisfaction score was 5. Based on these scores, we conclude that the graduates were elated with the powerful effect the critical thinking pedagogical treatment had on their daily lives.

Personal 2: In the following question, we asked if the treatment had affected their interactions with others. Again, the responses were enthusiastic, with the mean score of 5.24 with a standard deviation of 1.59. This result was statistically significant, Z=3.90, p=.00005. We concluded with a high degree of confidence that the critical thinking knowledge, skills, and strategies very positively affected the graduates' inter-personal relationships.

The graduates' strength of satisfaction was +1.24. The depth ratio and the breadth ratio were both greater than 6:1. Based on the Graduate Satisfaction score of 3, we concluded that the graduates were very satisfied with the effect that the critical thinking pedagogical treatment had on their interactions with others.

Personal 3: In the next question, we asked if the critical thinking treatment had affected the graduates' perceptions of the world around them. The mean score for this question was 5.48 with a standard deviation of 1.56, which was statistically significant, Z=4.75, p<.00003. This extremely positive result indicates that the graduates not only were transferring the knowledge, skills, and strategies acquired in the classroom into their daily lives, but also using it in their personal perception of the world around them. This is an extremely positive indicator of the need for such training. Graduates have modified their worldview, using critical thinking skills at the most basic human level.

The graduates expressed high levels of satisfaction, with a strength score of +1.48. Similarly their breadth ratio of 7:1, and their depth ratio of 8:1, expressed high levels of satisfaction. Based on the Graduate Satisfaction score of 3, we concluded that the graduates were very satisfied with the affects of the critical thinking pedagogical treatment on their perceptions of the world around them.

Personal 4: In the penultimate question, we asked each of the graduates if the critical thinking unit of instruction had affected their personal perception of themselves. The mean score for this question was 4.80 with a standard deviation of 1.87, which is significant, Z=2.14, p=.016. Although positive, this result was more reserved than the responses of the graduates in the previous three questions. The levels of satisfaction were also lower. The strength score was only +0.80, the breadth ratio was 3:1, and the depth ratio an anemic 2.6:1. The resultant Graduate Satisfaction score was only a 1. We concluded that the graduates were moderately satisfied with the positive affect the critical thinking pedagogical treatment had on their perceptions of themselves.

Personal 5: In the final question, we asked the graduates if the treatment had affected them in any way. These results were similar to those of the previous question. The mean score for this question was 4.88 with a standard deviation of 1.71. This result was statistically significant, Z=2.57, p=.005. Similarly, the strength score was only +0.88. The breadth ratio was only 4:1, while the breadth ratio was just 3:1. The Graduate Satisfaction score was only 2. We concluded that this positive result indicated the graduates were aware of changes in their perspective, at least in part attributing them to their perceptions of self, and that the graduates were satisfied that the critical thinking pedagogical treatment resulted in personal changes to themselves.

We were concerned with the differences in the scores of the first three of the personal questions and the last two questions. We tested the means of these five questions to determine if they were statistically different. We found that the mean of Personal 1 was significantly different from Personal 4 (Z=4.75, p=.0003) and different from Personal 5 (Z=4.37, p=.00003). Similarly, Personal 3 was significantly different from Personal 4 (Z=2.23, p=.013), and also from Personal 5 (Z=1.96, p=.025).

These results confirmed our observations, but did not help us to determine the reasons for the cognitive dissonance the graduates are reporting. Is it possible that the graduates are very satisfied with their external interactions, including their daily lives, perceptions and interactions, while less satisfied with the changes in themselves? Do they view their own changes as a necessary price to be paid for changes in other aspects of their lives? Is this just an expression of modesty, false modesty, or reticence to admit to being pleased by the changes they have experienced? Are some graduates ashamed, viewing their changes as a necessary price to be paid for changes in other aspects of their lives? Perhaps the changes that the graduates have experienced have been sufficiently slow and gradual, that they did not realize that they had changed or that their perceptions had changed. As such, intimations that they have been changed by the critical thinking treatment may not be as satisfying as their changes in external relations. They might even be ashamed, viewing their changes as a necessary price to be paid for changes in other aspects of their lives. Regardless, this is an interesting phenomenon, which deserves to be studied.

Again, we confirmed the graduates' understanding and use of critical thinking, based on their statements. One said, "It helps me look outside the box for other answers/solutions to decisions I need to make." A second stated, "I see the world differently. Instead of going for the surface, I tend to go deeper and look to the core." A third opined, "It usually only takes me a moment to recognize when someone lacks the ability to respond with a logical reply." A fourth admitted, "I am not saying that I am not naïve anymore, but I know I am a lot less naïve now." Another noted, "I try to analyze a situation from a different point of view when necessary." Another stated, "I have always been known as a person who thinks a lot what to do before I do things, but after I took this course it had help me a lot. I not only think before I do things, but now I think everything in a different perspective." A seventh respondent summarized their experience, as follows, "The best part of the critical thinking treatment was breaking apart ideas that were held to be 'truth' and finding out there are holes in that belief and possibly no validity to them." We interpreted these arguments, analogies, or statements as representative of or congruent with the knowledge, skills, or strategies the graduates learned in the critical thinking treatment.

Conclusion

Our study has shown that the pedagogical treatment was extremely successful in transferring the knowledge, skills, and strategies of critical thinking from the classroom into a variety of environments. Graduates report statistically significant transfers from the classroom and into their personal lives, their jobs, and their education. Further, our calculations of strength, breadth ratios, and depth ratios provide statistically compelling evidence that graduates were very satisfied with the critical thinking pedagogical treatment. Since the primary goal of education is transfer, then we concluded that the critical thinking pedagogical treatment is an outstanding success. Since a second goal of an institution of higher education is to satisfy the needs of students, we conclude that the critical thinking treatment instilled a high degree of satisfaction in the graduates of this college of business administration.

Future Studies

We have concluded that graduates who had received the pedagogical treatment in critical thinking had transferred the knowledge, skills, and strategies from the classroom environment into their personal, academic, and professional lives. Since the goal of education is transfer of knowledge from the classroom into the person's real life, then we may also conclude that we have succeeded.

We have also concluded that graduates were very satisfied with the strength, depth, and breadth of the critical thinking pedagogical treatment. If the goals of an educational curriculum include increasing recruitment, increasing retention, and improving graduation rates, then the critical thinking treatment is a highly effective course of study. If the ultimate goal of education is to provide the knowledge, skills and strategies needed by graduates to perform more effectively and efficiently in their academic, business, or personal lives, then the critical thinking pedagogical treatment is an important part of the curriculum.

Our conclusions based on statistical analyses were bolstered and confirmed by the statements of the respondents. These responses provided qualitative information relating to the survey questions using words, phrases, and reasoning processes they acquired in the critical thinking pedagogical treatment. These responses were congruent with Facione's third assessment of critical thinking skills. They are also congruent with research findings concerning persons trained in critical thinking and metacognitive understanding of themselves.

We recognize that ours is a limited study, which may not be applicable to other educational institutions, students, graduates or curricula. We encourage our colleagues in other institutions to continue this research. We especially encourage others to explore the cognitive dissonance we discovered in this study.

Finally, the results of our studies must be considered by curriculum committees at colleges and universities. We have demonstrated that critical thinking can be taught, can be learned, and can be transferred from the classroom into other domains. Critical thinking changes the way graduates perceive the world, perform their jobs, and interact with others. Critical thinking is important for graduate satisfaction. It could be important for student satisfaction, recruitment, and retention as well.

The reasons critical thinking is not taught in colleges and universities are unidentified. However, the continued intransigence of institutions of higher education towards teaching it and applying it throughout the curriculum is as incomprehensible as it is inexplicable.

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