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Evaluation of Critical Thinking and Reflective Thinking Skills among Science Teacher Candidates

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Abstract

The aim of this study was to evaluate and determine the critical thinking and reflective thinking skills of science teacher candidates. The study was performed with the participation of 30 teacher candidates enrolled in the science teaching department of a university in Turkey. Scales administered during the study included the California Critical Thinking Scale and the Reflective Thinking Skills for Problem Solving Scale. Frequency distributions were calculated for data obtained from both scales. Based on the study results, it was determined that while the teacher candidates generally provided responses that displayed effective critical and reflective thinking skills, the frequency of the responses for some of the scale items lacked a clear distribution in terms of illustrating the teacher candidates' stance towards these thinking skills.

Keywords: Critical thinking, Reflective thinking, Science teaching, Teacher candidate

1. Introduction

The 21st century is one of very rapid and continuous development around the world, which has very dynamic and cyclical effect on societies worldwide. Development leads to production, while production leads to further development. For this reason, the importance and effect of the ability to "think differently" is gradually increasing in all societies. Two forms of thinking that are particularly important in this context are critical thinking and reflective thinking.

Critical thinking is the ability to transfer knowledge learned from certain disciplines to other cognitive areas (Bronson, 2008). It involves not only the acquisition of information, but also active learning, problem solving, joint decision making, and the utilization of information (Kim, 2009). Critical thinking involves both a process and a product (Garrison, Anderson and Archer, 2001). During the acquisition of critical thinking skills and processes, the minds and bodies of students must be active and open to learning through scientific research. The acquisition of scientific reasoning skills allows individuals to progress to a new level of awareness by gaining new intellectual perspectives. This also enables the individuals to open to new horizons, and to thereby develop an interest in different areas of research (Dökme, 2005). Science applications, in particular, involve processes such as problem finding, problem solving, critical thinking, exploration, and investigation (Gomes, 2005). According to Aizikovitsh-Udi and Amit (2011), critical thinking encompasses questioning the reliability of information, and on accepting, rejecting, or questioning examples and knowledge from daily life.

On the other hand, similar to constructivist thinking, reflective thinking allows individuals (or students) to feel responsible for their own learning, to determine their own objectives, and to take part in learning processes (Demiralp and Kazu, 2012). Teachers in particular are expected to develop reflective thinking skills, and to gain critical reflective thinking on technical subjects (Duban and Yanpar Yelken, 2010). According to Şahin (2009), critical reflective thinking influences teachers' ability to question and reflect on events and processes, and to gain various perspectives on events. Developing different perspectives has an undeniable importance in present-day education. For this reason, the characteristics of teacher education are also very important. Education can be described as a process in which, in parallel to their integration into society, individuals also gain the ability to think critically (Dutoğlu and Tuncel, 2008). By ensuring the acquisition of reflective critical thinking among their students, reflective teachers support the development and teaching of advanced thinking skills; in this context, they contribute to the raising of citizens with positive traits that are much sought by advanced and productive societies (Duban and Yanpar Yelken, 2010).

Determining the critical and reflective thinking skills of science teacher candidates is fairly important for identifying the areas and abilities that need to be emphasized during their education. Ensuing that teacher candidates – teachers of the future – gain the necessary critical and reflective thinking skills is likely to have a significant positive impact on their training. For this reason, it is important to identify and utilize effective means for assessing these thinking skills among teacher candidates. In this context, the aim of this study was to determine the critical and reflective thinking skills of science teacher candidates.

2. Methods

The study was conducted with 30 second-year university students receiving education in the science teaching department of an education faculty in a Turkish university. This descriptive study was designed according to a screening study design. The aim of this study was to determine the current critical and reflective thinking skills of science teacher candidates.

2.1. Data Collection Tools

Two main assessment tools were employed in this study, which were the California Critical Thinking Scale and the Reflective Thinking for Problem Solving Scale. The original California Critical Thinking Scale was developed by Facione, Facione, and Giancarlo in 1998, and adapted to Turkish by Kökdemir in 2003. This six-point Likert-type scale consisted of the answers: "*Strongly Disagree (SD), Disagree (DG), Partly Disagree (PD), Partly Agree (PA), Agree (AG), and Strong Agree (SA),*" and the internal consistency coefficient of the scale was previously determined as 0.88. The other assessment tool employed was the Reflective Thinking for Problem Solving Scale developed by Kızılkaya and Aşkar (2009). The said scale is a five-point Likert-type scale with a Cronbach's Alpha value of 0.83.

3. Results

The results obtained from the research are given in table1 and table2.

Table 1. The frequency distribution of critical thinking skills among science teacher candidates.

Scale Items	SD	DG	PD	PA	AG	SA
It would be great to learn new things throughout my entire life.	3.3	3.3	0.0	30.0	40	23.3
It bothers me when people rely on weak arguments to defend good opinions.	3.3	6.7	0.0	13.3	66.7	10.0
Before giving an answer, I always focus on the question first.	0.0	6.7	0.0	13.3	50.0	23.3
I value my ability to think with great clarity.	0.0	0.0	10.0	23.3	50.0	16.7
If there are four views in favor of, and one view against an argument, I would tend to side with the four favorable opinions.	6.7	36.7	10.0	40.0	6.7	0.0
Many university courses are uninteresting and not worth understanding.	6.7	16.7	26.7	26.7	13.3	10.0
I prefer exams where one needs to apply thinking rather than memorizing information.	0.0	0.0	0.0	10.0	53.3	36.7
Other individuals appreciate my intellectual inquisitiveness and research-oriented personality.	3.3	16.7	10.0	30.0	40.0	0.0
I act as if I were rational, while in fact I am not.	40.0	43.3	3.3	10.0	0.0	3.3
I find it easy to organize my thoughts.	3.3	3.3	6.7	23.3	46.7	16.7
Everyone, including myself, generally engages in debates and arguments out of self-interest.	6.7	30.0	16.7	20.0	23.3	3.3
Keeping records of my personal expenditures is very important for me.	3.3	6.7	10.0	20.0	53.3	6.7
When confronted with a big and important decision, I first try to collect as much information as I can.	0.0	0.0	10.0	16.7	53.3	20.0
Since I make decisions judiciously by properly taking the "rules" into account, my friends generally consult and trust me with their own decisions.	0.0	10.0	10.0	30.0	43.3	6.7
Being open-minded means not knowing what is right and what is wrong.	40.0	46.7	0.0	6.7	3.3	3.3
It is important for me to understand what other people think on various subjects.	0.0	0.0	6.7	16.7	53.3	23.3
All my beliefs must have a solid and tangible basis.	0.0	10.0	3.3	13.3	66.7	6.7
Reading is something I avoid whenever I can.	40.0	30.0	13.3	3.3	6.7	6.7
People generally say that I am too hasty when taking decisions.	20.0	43.3	6.7	20.0	10.0	
Elective courses in university are a waste of time.	16.7	40.0	6.7	20.0	13.3	3.3
I panic whenever I have to deal with something truly and excessively complex.	6.7	13.3	16.7	36.7	20.0	6.7

Rather than describing their culture to us, foreigners should try to understand our culture.	13.3	30.0	10.0	16.7	23.3	6.7
People generally think that I procrastinate when it comes to making decisions.	23.3	43.3	13.3	13.3	6.7	0.0
When people oppose the opinions of others, they must do so based on concrete reasons.	0.0	0.0	3.3	3.3	66.7	26.7
It is impossible for me to be impartial when discussing my own opinions.	6.7	20.0	13.3	26.7	30.0	3.3
I admire my own ability to present creative choices and solutions.	0.0	0.0	3.3	16.7	50.0	30.0
I believe whatever I want to.		13.3	16.7	33.3	20.0	16.7
Spending a lot of effort for solving complex problems is really not all that important.	6.7	66.7	10.0	13.3	0.0	3.3
Other people often consult me to determine reasonable standards concerning the implementation of their decisions.	3.3	10.0	13.3	26.7	43.3	3.3
I am always willing to learn things that are challenging.	0.0	10.0	20.0	23.3	36.7	10.0
It is important to try to understand the thoughts/opinions of foreigners.	0.0	20.0	13.3	26.7	20.0	20.0
My curiosity is one of my greatest strengths.	0.0	6.7	16.7	33.3	26.7	16.7
I always seek information that supports my views, while avoiding those that contradict my views.	3.3.	26.7	10.0	36.7	23.3	0.0
Solving complex problems is fun.	0.0	10.0	6.7	36.7	40.0	6.7
People admire my ability to understand the thoughts of others.	3.3	3.3.	6.7	23.3	53.3	10.0
Analogies and metaphors are only as useful as boats on a highway.	20.0	46.7	10.0	6.7	16.7	0.0
I can be described as a reasonable person.	0.0	3.3	3.3	30.0	50.0	13.3
I really enjoy trying to understand how everything works.	0.0	0.0	10.0	26.7	43.3	16.7
When a problem get complicated and challenging, others often ask me to keep working on it.	0.0	13.3	10.0	26.7	36.7	3.3
Developing an open view about a problem at hand should always be a first priority.	0.0	13.3	13.3	0.0	53.3	16.7
My opinion of controversial subjects is generally shaped by the last speaker.	30.0	33.3	6.7	23.3	3.3	0.0
Regardless of the circumstances, I am always interested in learning more about a subject.	0.0	6.7	16.7	40.0	30.0	3.3
The best way to solve a problem is to ask for the answer from someone else.	40.0	46.7	0.0	3.3	3.3	3.3
I am described as having an orderly and systematic approach towards complex problems.	3.3	13.3	16.7	33.3	20.0	10.0
Having an open mind towards different world views is less important than what people actually think.	20.0	40.0	3.3	13.3	20.0	0.0
Learn everything you can, since you never know when you might need it.	0.0	0.0	0.0	6.7	56.7	33.3
Nothing is ever as it seems.	20.0	63.3	3.3	3.3	6.7	0.0
Other people let me decide how a problem should be solved.	3.3	20.0	13.3	30.0	26.7	3.3
I know what I think; so why should I pretend that I am considering other views and options?	3.3	30.0	23.3	16.7	16.7	6.7
Others express their opinions, but I am not interested in listening to them.	30.0	30.0	23.3	0.0	10.0	3.3
I am good at developing orderly plans for resolving complex problems.	3.3	3.3	13.3	36.7	30.0	10.0

An evaluation of the data in Table 1 indicates that many of the teacher candidates provided responses that showed a strong inclination for critical thinking. However, in certain items, the frequencies of the responses were distributed both in favor of and against critical thinking. Examples include the percentage distribution of the responses to the following items: “If there are four views in favor of, and one view against an argument, I would tend to side with the four favorable opinions,” “I always seek information that support my views, while avoiding

those that contradict my views," "It is impossible for me to be impartial when discussing my own opinions" and "Many university courses are uninteresting and not worth understanding."

Table 2. The frequency distribution of reflective thinking skills among science teacher candidates.

Scale Items	Always	Most of time	Sometimes	Rarely	Never
When I fail to solve a problem, I ask myself questions to understand why I was not able to solve it.	13.3	83.3	3.3	0.0	0.0
After I solve a problem, I ask myself whether I can find even better ways of solving it.	0.0	43.3	40.0	13.3	3.3
I question the solutions of my friends, and try to find better ones.	0.0	66.7	23.3	10.0	0.0
I reassess possible solutions again and again, so that I may be better able to solve the next problem.	10.0	56.7	33.3	0.0	0.0
When solving a problem, I act by carefully considering the methods I use.	20.0	70.0	6.7	3.3	0.0
After I solve a problem, I examine and reevaluate the methods I have used.	13.3	46.7	30.0	10.0	0.0
When solving a problem, I ask myself questions in order to come up with different solutions.	3.3	36.7	43.3	13.3	3.3
When solving a problem, I think of the reason why I have used a particular method, and try to determine its relationship with the outcome of the solution.	13.3	60.0	16.7	10.0	0.0
When I read a problem, I consider the information that I need for solving it.	23.3	73.3	3.3	0.0	0.0
After I solve a problem and find a solution, I check the methods I have used.	20.0	56.7	20.0	0.0	3.3
When I read a new problem, I think of the problems I have solved before, and establish a relationship between these two based on their similarities and differences.	10.0	63.3	23.3	0.0	3.3
When solving a problem, I always think about the previous and ensuing steps of the method being used.	13.3	56.7	26.7	0.0	3.3
When I read a problem, I ask myself questions to better understand the information being provided, and the solution that is requested.	16.7	66.7	3.3	13.3	0.0
After completing a problem, I make comparisons between the solutions of my friends, and assess my own solution accordingly.	16.7	36.7	40.0	3.3	3.3

An evaluation of the data in Table 2 indicates that many of the teacher candidates provided responses that showed a strong inclination for reflective thinking. However, in certain items, the frequencies of the responses were distributed both in favor of and against reflective thinking. Examples include the percentage distribution of the responses to the following items: "After completing a problem, I make comparisons between the solutions of my friends, and assess my own solution accordingly," "When solving a problem, I ask myself questions in order to come up with different solutions," and "After I solve a problem, I ask myself whether I can find even better ways of solving it."

4. Results and Discussion

As demonstrated by the frequencies of the study results, the science teacher candidates generally exhibited a positive stance towards their own critical and reflective thinking. However, we also noted that in both scales, the frequency of certain items displayed a rather inconsistent distribution. These items showed that the teacher candidates' responses lacked a clear distribution with regards to agreeing with the opinion of the majority; researching opinions that do not support their own views; being impartial when discussing their own views; being impartial when debating issues relating to their own interests; believing in the necessity of courses taken in university; evaluating the solutions to problems by making comparisons with their friends; reassessing the solution to a problem; and in asking questions to one's self when solving or after solving a problem in order to consider different possible solutions. This indicates that these science teacher candidates need to further improve their critical thinking skills and self-efficacy. Critical and reflective thinking skills are two types of advanced

thinking skills that support and reinforce one another. For this reason, developing these two skills is highly important for gaining the ability to see, think, research, question, and resolve events in a scientific way – or a "scientific outlook." To be able to effectively reflect and share this advanced scientific outlook to elementary school students, science teacher candidates must successfully acquire this scientific perspective.

In this context, to ensure the development of critical thinking skills during formal education, it is generally recommended that different perspectives are considered and used during classes, and that these skills are practiced actively by employing suitable techniques (Bulut, Ertem, and Sevil, 2009). In his study, Tok (2008) describes that reflective thinking activities are effective for improving student performance and attitudes towards the science class, and that teachers should be trained on the implementation of such activities in classroom environments by receiving both pre-service and in-service trainings. Therefore, we believe that it is very important to identify and further develop both the critical and reflective thinking skills of science teacher candidates during their education.

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