Testing Factor Structure of California Measure of Mental Motivation Scale in Turkish Primary School Students and Examining Its Relation to Academic Achievement

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Abstract: California Measure of Mental Motivation Scale (CM3) is a scale developed to measure “critical thinking disposition”. The main aim of the study is to use confirmatory factor analysis to determine whether the original and adapted forms of CM3 have valid factor structures. Another purpose is to examine correlations between CM3 scores and academic achievements related to different school subjects. 570 primary school students in Ankara-Turkey were included in the study conducted based on general survey model. The present study showed that both the original factor structure and the adapted form of CM3 were valid models. When correlations between academic achievements related to different school subjects and CM3 scores were examined, it was determined that Cognitive Integrity subscale had highest and most significant correlations. There are significant yet negative correlations between Creative Problem Solving and Learning Orientation subscales and lesson achievements.

Keywords: California measure of mental motivation • confirmatory factor analysis • critical thinking disposition • turkish students

INTRODUCTION

Each day, we are more and more aware of the fact that critical thinking skill is essential for success in life. The main significance of education is to teach students how to get involved in a modern society which is based on knowledge and technology as active and responsible people or in other words, how to be good citizens. Therefore, teaching young generations' critical thinking skill is one of the main future goals of all societies in the world.

Critical thinking as a mental development process generally aims at increasing students’ potentials in the following three fields: Developing students’ argumentative skills, understanding cognitive process and intellectual development [1]. Moreover, it is ascertained that critical thinking focuses on “analyzing and assessing clues” [2].

General attitude in classical education systems is transferring a thinking system true to teachers and certain values or beliefs from one person to the other [3]. In classical education, a student is an ineligible receiver. Knowledge provided by teachers is absolutely and undisputedly right. There is no need for implication during information transfer because information is provided in a manner that enables students to memorize easily. Students consider everything in textbooks right without any criticisms. Teachers have the final say in their fields and it is not possible for a student to contribute to the teacher’s knowledge with something new [4]. There is even evidence in the literature which shows main tasks of teachers in classical education such as keeping the class silent, keeping up with the lesson plan of the day and coaching students for routine examinations [5].

With didactic and phenomena-based teaching attitude observed in classical education systems, students are generally taught the content of a lesson as the traditional lesson format and they do not think about what they have learned. Learning is mostly based on recalling. Students do not cope with logical or theoretical gaps in the lesson content [6]. In classical education system, theories of old scientists, their ideas and points of view are very well taught but teachers are not interested in things such as thinking education and thinking exercises [4].

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However, in critical thinking approach, there is a learner-centered paradigm and the student has an active role in the process. In this teaching method, the content of a lesson appears within thinking. Only those who think during the content can improve in the process. Teaching based on critical thinking approach consists of thinking on thinking [6]. At this point, learning by questioning is in the foreground instead of memorizing. The task of a teacher is to guide teaching and enabling students to access information instead of transferring information. Critical thinking is irrelevant in classical education. It is in the nature of learner-centered teaching, but it is undetermined how to come up with critical thinking. In learner-centered educational model, teachers and students have equal responsibilities and since both parties are ready for the lesson there is no loss of topic and no harm by the mechanism in the traditional boring education that terminates thinking [7].

In Turkish education system, which is considered as a classical education system, there were significant changes with Basic Education Reform in 1997. One of the most important elements of the reform movement that entailed the eight-year-compulsory education was “changes in the curriculum”. It was seen that a transferring philosophy from “teacher-centered teaching” to “learner-centered teaching” formed the basis of the changes in the primary school curriculum and this kind of understanding led to the necessity of using certain teaching methods like active learning, cooperative learning and problem-based learning. In other words, we might suggest that the main change in teaching was transfer to efficient critical thinking and active participation from memorizing and passive practices. Some common skills to be gained through the new primary school curricula were determined and it was highlighted that it was necessary to include those skills in the basis of all lessons. One of the skills was “critical thinking skill”.

Critical thinking is the skill of combining, using and applying assumptions, attitudes and knowledge. It means systematically and logically examining evidence to support results, building up a logical connection between evidence-result and producing situations that are supported by evidence [4, 8, 9]. Cognitive skills that form critical thinking are not solely sufficient in order to understand and explain critical thinking. It is essential to take one of the most characteristic elements of critical thinking into account, which is “disposition towards critical thinking”. Since although individuals have these skills, they may not have enough internal motivation to use them efficiently. This case may lead to a misinterpretation which assumes these individuals are deprived of those skills. Enthusiasm by individuals to use skills is considered as “Disposition towards critical thinking” and it can be defined as the basis of critical thinking [10-14].

Disposition towards critical thinking is seen as a dimension of personality. This disposition is defined as being enthusiastic and motivated to use critical thinking skills constantly while dealing with important problems, making decisions and solving problems [10-12, 14, 15].

In literature there are various measuring tools available developed for measurement of both critical thinking skill and disposition towards critical thinking. Some of the tools were adapted into Turkish culture. For instance, Watson-Glaser Critical Thinking Appraisal Scale Form YM, which measures critical thinking skills [8], Watson-Glaser Critical Thinking Appraisal Scale Form S [16] and California Disposition Towards Critical Thinking Scale [4]. Yet, it is useful to state that all these scales are used in high schools and universities.

As mentioned before, one of the most important goals of Basic Education Reform in Turkey is to develop critical thinking by curricula changes. However, there were not any tools to measure primary school students’ dispositions towards critical thinking. For this reason, Ozdemir [17] adapted California Measure of Mental Motivation Scale (CM3) into Turkish culture.

CM3 original form consists of four subscales. The first subscale “Learning Orientation” shows a person’s enthusiasm to increase knowledge and skills. It is defined as the disposition toward increasing one’s knowledge and skill base, giving importance to the learning process as a means to accomplish mastery over a task, being interested in challenging activities and using information seeking as a personal strategy in problem solving.

Second subscale “Creative Problem Solving” is defined as disposition towards problem solving with new, original ideas and solutions; considering oneself as creative, skillful and sufficient to solve difficult problems; enthusiasm to take part in activities like puzzles, strategy games etc. and being able to understand covert functions of objects. “Mental Focus”, the third subscale, is defined as being diligent, systematic, task-oriented, organized and feeling relaxed while dealing with problem solving activities, being capable of completing a task on time and being systematic. “Cognitive Integrity”, the last subscale, is defined as disposition towards ensuring interaction between different points of view to learn the truth and reach the best decision, displaying strong mental curiosity and considering an unbiased approach to alternative standpoints as valuable [14].
Aim: The main aim of the study is to use confirmatory factor analysis to determine whether the original and adapted forms of CM3 have valid factor structures. Another purpose is to examine correlations between CM3 scores and academic achievements related to different school subjects such as mathematics, Turkish language, social knowledge, science and technology and English language.

MATERIALS AND METHOD

Participants: 570 primary school students (grades 6-8) from five different primary schools in two districts of Ankara were included in the study conducted based on general survey model. One grade from each level from all the schools was included. Therefore, there were 170 students (29.80%) from grade six, 198 students (34.70%) from grade seven and 202 students (35.40%) from grade eight in the study group. 277 of the students were female (48.60%) and 293 of them were male (51.40%).

Instruments: In the present study, California Measure of Mental Motivation Scale (CM3), whose factor structure was examined to see whether it was a valid model or not, was developed by Giancarlo and Facione to measure critical thinking dispositions of students from grades 6-12 [13] and adapted into Turkish culture by Özdemir [17].

The scale structure of the original form of CM3 consists of four subscales. In the 25-item-scale, there were six items (items 1-6) in “Learning Orientation”, the first factor of the scale. In “Creative Problem Solving” and “Mental Focus” subscales, which are the second and the third subscales consist of seven items (items 7-13 and items 14-20, respectively). The fourth subscale “Cognitive Integrity” consists of five items (items 21-25). The scale is a four point Likert type as “I totally agree (4)” and “I totally disagree (1)” [14].

The exploratory factor analysis with varimax rotation of the Turkish form of CM3 revealed that the scale had a four-factor-structure similar to the original form with several differences. In the Turkish form, some items changed places under different factors and one item was excluded since it had high factor loading in more than one factor. In the Turkish form consisting of 24 items, there were six items under “Learning Orientation” subscale (1, 4, 5, 6, 17 and 18). There were seven items in “Creative Problem Solving” subscale (2, 7, 8, 9, 10, 11, 12), six items in “Mental Focus” (13, 14, 15, 16, 19, 20) and five items in “Cognitive Integrity” (21-25). As mentioned before, item 3, “Being eager to learn about different things is one of my strong points”, had high factor loading in more than one factor.

Cronbach-Alfa internal consistency coefficients were calculated for reliability and these coefficients are as follows: Creative Problem Solving $\alpha = 0.63$; Learning Orientation $\alpha = 0.66$; Mental Focus $\alpha = 0.64$; Cognitive Integrity $\alpha = 0.60$ and the whole scale $\alpha = 0.78$. Test-retest reliability coefficient including 105 students at a five-week-interval was significant ($r = 0.73$, $P<0.01$) and sufficient.

Data analysis: Confirmatory factor analysis was applied to determine whether the original and adapted forms of CM3 had valid factor structures. CFA is a frequently used technique to find out and reveal covariance and variance resources of the observed measures. CFA aims at discovering factor(s) based on correlations between variables [18]. It pursues a goal to confirm an already determined or designed structure. CFA is based on exploratory factor analysis and similarly, serves to determine construct validity of the scale. Also, Pearson correlation coefficient method was used to examine correlations between CM3 scores and academic achievements related to different school subjects such as mathematics, Turkish language, social knowledge, science and technology and English language.

RESULTS

In this section, findings on confirmatory factor analysis of the original and Turkish forms of CM3 was presented in the first place and then results of Pearson correlation coefficient correlations were presented.

CM3 original form confirmatory factor analysis results: In this study, confirmatory factor analysis of the original and the Turkish forms was conducted with 200 students randomly chosen from the participants with the reason that CFA was sensitive to the sample size. Therefore, it is desirable that chi-square ($\chi^2$), firstly assessed fit index, should not be significant in terms of acceptability of the model. However, it is almost always significant in large samples. Tanaka et al. suggested that for normally distributed data, $n=100$ generally at minimum level and $n=200$ were considered as preferable limits [19].

As a result of CFA concerning the scale construct of the original CM3, goodness of fit indexes were found $\chi^2 = 331.85$; (df = 268, $P = 0.0048$), $\chi^2/df = 1.238$, RMSEA=0.035, RMR=0.17 and the standardized RMR = 0.071, GFI = 0.88, CFI = 0.98, AGFI = 0.86. In the literature,
Table 1: Correlations between CM3 scores and academic achievements related to school subjects

<table>
<thead>
<tr>
<th>CM3 scores</th>
<th>School subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
</tr>
<tr>
<td>Creative problem solving</td>
<td>-0.23**</td>
</tr>
<tr>
<td>Learning orientation</td>
<td>-0.23**</td>
</tr>
<tr>
<td>Mental focus</td>
<td>0.04</td>
</tr>
<tr>
<td>Cognitive integrity</td>
<td>0.29**</td>
</tr>
<tr>
<td>Total score</td>
<td>-0.03</td>
</tr>
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</table>

**p<0.01, *p<0.05

When the χ²/df rate calculated by CFA is lower than 3, it means that the factorial model being tested is in accordance with the real data [20]. On the other hand, GFI value lower than 0.85, AGFI value higher than 0.80 and RMR value lower than 0.10 are taken as a criterion for the model to be in accordance with real data [21, 22]. It was seen that all the correlations between the factors included in the model and the items included in that factor were higher than 0.30 and significant at a level of 0.01. Besides, there was a modification between two items (14 and 15), since it significantly contributed to a decrease in chi-square value.

As a result, it might be suggested that goodness of fit indexes calculated using the data from the present study meet the criteria and the four-factor-structure of CM3 original form is an eligible, valid model.

CM3 Turkish form confirmatory factor analysis results:
Validity tests concerning CM3 original form were also applied to the scale construct of the Turkish form. CM3 Turkish form’s goodness of fit indexes were found χ² = 313.87; (df = 246, P = 0.0022), χ²/df = 1.276, RMSEA = 0.037, RMR = 0.17 and the standardized RMR = 0.073, GFI = 0.88, CFI = 0.98, AGFI = 0.86. When the correlation coefficients calculated between the factors included in the model and the items included in that factor were examined, it was determined that all of these values were higher than 0.30 and all the item-factor correlations observed were found significant at a level of 0.01.

As a result, it might be suggested that goodness of fit indexes calculated using the data from the present study meet the criteria and the four-factor-structure of CM3 Turkish form is an eligible, valid model.

In the light of the second aim of the study, correlations between CM3 scores and academic achievements related to different school subjects such as mathematics (M), Turkish language (TL), social knowledge (SK), science and technology (ST) and English language (EL) were examined and the related results were presented in Table 1.

When the correlations between CM3 scores and academic achievements related to school subjects presented in Table 1 are examined, it is seen that there is no significant correlation between CM3 total score and academic achievements. A similar case also applies to “Mental Focus” subscale. Accordingly, a significant correlation was found (r = 0.59; p < 0.05), only in science and technology lesson, yet the correlation was very low. The subscale that gave the highest and the most significant correlations to school subjects was “Cognitive Integrity”. There were significant but negative correlations between “Creative Problem Solving” and “Learning Orientation” subscales and achievement.

**DISCUSSION**

Individual cognitive skills are not sufficient to consider one as a good critical thinker; s/he should also be willing to use these skills. In other words, s/he should tend to think critically and have qualities of curiosity, research, seeking for evidence, taking intellectual risks and etc. It is possible for individuals to have such qualities through an education that contributes to development of these skills from the very beginning.

CM3 is a scale adapted into Turkish culture to measure dispositions towards critical thinking of the students in grades 6-8 of primary education. The present study showed that both the original and Turkish forms’ constructs within the framework of the research were eligible and valid models. However, it is suggested that CFA original form results should be used for crosscultural comparative studies.

When correlations between CM3 scores and academic achievements related to different school subjects (mathematics, Turkish language, social knowledge, science and technology and English language) were examined, it was determined that “Cognitive Integrity” had the highest and the most significant correlations. Therefore, it might be said that these school subjects contribute to the development of
qualities like dispositions of the students towards ensuring interaction between different points of view to learn the truth and reach the best decision, displaying strong mental curiosity and considering an unbiased approach to alternative standpoints as valuable.

There are significant but negative correlations between “Creative Problem Solving” and “Learning Orientation” and academic achievement. In other words, high academic achievement does not necessarily mean that students’ dispositions towards considering learning process valuable, being interested in challenging activities, using personal background in problem solving, approaching to problem solving with new, original ideas and solutions, considering himself as creative, skillful and capable of solving difficult problems are high. On the contrary, it seems that students with high dispositions have low academic achievements and vice versa. These findings might be related to achievement understanding of Turkish students. It is not necessary to have developed qualities or dispositions to be successful in the system that still has classical education effects. Although a learner-centered education understanding forms the basis of curricular changes and it is emphasized that critical thinking development is one of the main goals of Turkish education system, some time will be needed to reduce those impacts and change student achievement understanding.

Moreover, it should be considered that most teachers have been in service of classical education for years and were taught such an understanding. Therefore, teachers cannot create a learning atmosphere and fail to motivate the students to use disposition potential. This could be related to the meaning and value of learning process and success. Besides, this situation is supported by the fact that disposition total scores cannot be correlated with academic achievement related to different school subjects. Another reason could be considered as the failure to make sound success measurements. Eventually, there are changes needed in both students’ and teachers’ perspectives of education.

As a result, disposition towards critical thinking is vital since it will affect individuals’ motivation to use critical thinking skills. Developing these dispositions and skills from the very beginning in education will help students have advanced cognitive skills that they will be in lifelong use. In Turkey, where the effects of the classical educational system are still felt, it is clear that other studies on disposition towards critical thinking and critical thinking skills are needed. Lessons should be related to these advanced cognitive skills and academic achievement should be parallel to the use of these skills. Furthermore, teachers should also have the same perspective and consciousness.

REFERENCES