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Normalization and Validation a Tool for Measuring Scientific Thinking in Iranian Students

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Purpose: One of the most important dimensions of thinking is scientific thinking, which can play an effective role in improving the academic conditions of students. Therefore, the purpose of this study was normalization and validation a tool for measuring scientific thinking in Iranian students.

Methodology: This study in terms of purpose was applied and in terms of implementation method was descriptive from survey type. The research population was all high school students in Mashhad city in the 2020-21 academic years. The sample size based on Cochran's formula and with 10% attrition was calculated 648 people, which this number were selected by multi-stage cluster sampling method. The research tool was a Liang et al scientific thinking questionnaire (2006), and the resulting data were analyzed by confirmatory factor analysis in SPSS 26 software.

Findings: The findings showed that among the 24 items of the scientific thinking questionnaire, the content validity index of all items was approved because it was higher than 0.70, and only the content validity ratio of 4 items was inappropriate because it was lower than 0.50, and these items were revised and modified. Also, the scientific thinking questionnaire had 24 items in 6 components of using from scientific methods, using from scientific theories and laws, social contexts and culture, creativity and visualization, observation and inference, and practice; So that the factor load of all items was higher than 0.60, the average extracted variance of all components was higher than 0.50, and the Cronbach and combined reliability of all components was higher than 0.70. In addition, the reliability of the total scientific thinking questionnaire was obtained with the Cronbach's alpha method 0.86 and with the combined method 0.93.

Conclusion: The results showed that the a tool for measuring scientific thinking in students has a good validity and experts and educational planners can use this tool to measure the level of scientific thinking of students and based on its components design and implement programs to improve and promote scientific thinking.



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Extended Abstract

Purpose: Despite the emphasis and attention to the problem and thinking in the educational systems and the claims of officials, supervisors and educational executives, in practice there is not enough will and motivation to encourage students to think. One of the special characteristics of humans is having the power of thinking, and educational systems including education always seek to grow and improve thinking. Therefore, the aim of educational systems is to create and improve thinking ability in learners. Thinking as a cognitive activity is a complex form of human behavior and the highest and prominent form of intellectual and mental activity, and the goal of every educational system is to educate thoughtful, creative, critical and scientific learners who can manage their lives in the best way. In addition, the growth and cultivation of students' intellectual skills has always been a serious and complex issue in education, but today it has become critical. Because in recent years, educational sciences experts express concern about people's inability and weakness in thinking. If the education system seeks to cultivate thinkers, thinkers and philosophers, it should design and implement programs to teach thinking to students, which there are two different approaches in this field. Some believe that teaching thinking like subjects such as reading and math should occupy a part of the classroom hours, and others believe that teaching thinking should be included in all subjects and curricula. People in different ways understand and judge the world and solve issues and problems; Some people rely more on instincts and inner feelings, and others rely on important aspects, main elements of issues and consequences. Therefore, there are different ways of thinking, one of which is scientific thinking. Scientific thinking is a part of the skills of the 21st century that prepares children to enter the knowledge-based society, and this term corresponds to the search for knowledge and includes the type of purposive thinking in order to increase one's knowledge. The modern views and theories about scientific thinking are based on the constructivist approach, and based on this approach, learning and understanding of scientific concepts is formed and built by people according to their experiences. Scientific thinking as a complex set of cognitive and metacognitive skills were included the application of the method or principles of scientific exploration and reasoning in problem solving situations, which includes various skills in hypothesizing, testing, changing theories, and the process of acquiring knowledge. One of the most important dimensions of thinking is scientific thinking, which can play an effective role in improving the academic conditions of students. Therefore, the purpose of this study was normalization and validation a tool for measuring scientific thinking in Iranian students.

Methodology: This study in terms of purpose was applied and in terms of implementation method was descriptive from survey type. The research population was all high school students in Mashhad city in the 2020-21 academic years. The sample size based on Cochran's formula and with 10% attrition was calculated 648 people, which this number were selected by multi-stage cluster sampling method. The sampling was done in this way, which first the Mashhad city was divided into a number of districts and three districts were randomly selected from among them, and in the next step a number of schools randomly were selected from each district, and finally a number of classes randomly were selected from each school and all the students of the selected classes were selected as a sample if they had the conditions to enter the study. The conditions to enter the study in the present study were included no failure in the previous grades, living with parents, no stressful events such as divorce and death of relatives in the past three months, no use of psychiatric drugs such as anti-anxiety and etc., no receipt of psychological services in the last three month and the desire to participate in the research and the consent of their parents for this purpose. Also, the conditions of withdrawal from the study in the present study were included refusal to continue cooperation and completing the tools and failure to respond to more than ten percent of the items. The research tool was a Liang et al scientific thinking questionnaire (2006) which tool as a self-report tool had 24 items in six components of using from scientific methods, using from scientific theories and laws, social contexts and culture, creativity and visualization, observation and inference, and practice. To answer each of the items was used a five-point scale including I completely disagree with a score of one, I disagree with a score of two, indifferent with a score of three, I agree with a score of four, and I completely agree with a score of five. The score of each component was calculated with the total score of the constituent components of that component, and a higher score indicated more of that feature. The data obtained from the implementation of the self-report scientific thinking questionnaire were analyzed by confirmatory factor analysis in SPSS 26 software.

Findings: The findings showed that among the 24 items of the scientific thinking questionnaire, the content validity index of all items was approved because it was higher than 0.70, and only the content validity ratio of 4 items was inappropriate because it was lower than 0.50, and these items were revised and modified. Also, the scientific thinking questionnaire had 24 items in 6 components of using from scientific methods, using from scientific theories and laws, social contexts and culture, creativity and visualization, observation and inference, and practice; So that the factor load of all items was higher than 0.60, the average extracted variance of all components was higher than 0.50, and the Cronbach and combined reliability of all components was higher than 0.70. In addition, the reliability of the total scientific thinking questionnaire was obtained with the Cronbach's alpha method 0.86 and with the combined method 0.93.

Conclusion: In general, the results of this study showed that the a tool for measuring scientific thinking in students has a good validity and experts and educational planners can use this tool to measure the level of scientific thinking of students and based on its components design and implement programs to improve and promote scientific thinking. Therefore, to the administrators and officials of the field of education it is suggested to evaluate the state of scientific thinking in students and to use appropriate strategies to improve and promote the scientific thinking of students according to the current state of scientific thinking and looking at the desired situation.