This study purports to develop a self-report instrument for identifying mathematically gifted students and to investigate the relationship between students’ self-perceptions and mathematical giftedness. The study was conducted among 359 4th, 5th and 6th grade elementary school students in Cyprus, using a self-report questionnaire of 20 statements on a 5-point Likert type scale. The results of the study revealed that students’ self-perceptions of mathematical behavior can be described across five dimensions; (a) learning characteristics, (b) interests/curiosity, (c) creativity, (d) social-emotional characteristics and (e) mathematical reasoning. Additionally, it was found that the self-report questionnaire could predict mathematical giftedness, which comprises of mathematical ability and creativity.

Keywords: giftedness, self-report questionnaire, mathematical ability, creativity.

Theoretical Framework
The identification of gifted students has long been a controversial issue (Ziegler, 2009). Since the concept of giftedness has not been clarified yet, the identification of mathematically gifted students is considered to be extremely challenging (Hoeflinger, 1998). Despite several publications introducing various conceptions of giftedness, only a small number of them have been subjected to adequate empirical examination (Stoeger, 2009). Therefore, the need for more empirical studies in the future is evident.

According to Csikszentmihalyi (2000) giftedness is field-dependent. However, prior research in the field of giftedness was predominantly concerned with the notion of general giftedness rather than domain-specific giftedness, for instance mathematics. Thus, there is limited focus on theoretical models of mathematical giftedness as well as specially designed procedures and instruments for students’ identification.

Among the conceptualizations of giftedness that have been proposed over the years, a widely accepted definition was proposed by Renzulli (1978), emphasizing above-average ability and creativity as characteristics of gifted individuals. Several researchers have argued about the relationship between mathematical giftedness and creativity (e.g. Sriraman, 2005) and their importance during the identification process. Others researchers suggested that gifted students can also be identified by examining students’ learning pace, depth of understanding and interests (Maker, 1982). This wide variety of characteristics of gifted individuals calls upon the use of a multiple-criteria approach during their identification, using a combination of valid and reliable tools (Hoeflinger, 1998). Among other instruments, tests, self-report questionnaires, teacher rating scales, checklists and inventories have been introduced as measures of the identification of giftedness.

Having in mind the abovementioned considerations, the purpose of this article is twofold. Firstly, the study attempts to develop a valid and reliable self-report instrument for identifying mathematically gifted students. Secondly, the study investigates the relationship between students’ self-perceptions and mathematical giftedness, which comprises of mathematical ability and creativity.

A theoretical model was created assuming that students’ self-perceptions of their own characteristics in mathematics can be described across the following dimensions: (a) learning characteristics, (b) interests/curiosity, (c) creativity, (d) social-emotional characteristics and (e) mathematical reasoning.
characteristics, (b) interests/curiosity, (c) creativity, (d) social-emotional characteristics and (e) mathematical reasoning. Furthermore, it was assumed that this instrument would contribute to the prediction of students’ mathematical giftedness which consists of mathematical ability and creativity.

**Methodology**

To fulfil the aims of the study, three instruments were administered to 359 students of age 9-12 years old; the self-report questionnaire, the mathematical abilities instrument and the mathematical creativity instrument. The self-report questionnaire consisted of 20 statements describing behaviors with special focus on mathematics. Students responded on a 5-point Likert scale regarding the frequency of each behavior observed. The mathematical instrument comprised of 29 mathematical items measuring Spatial, Quantitative, Qualitative, Causal and Inductive/Deductive abilities. The creativity instrument included five open-ended multiple-solution mathematical tasks.

For the analysis of the data confirmatory analysis was employed using the statistical package MPLUS. In this study, confirmatory factor analysis (CFA) was used to investigate whether the proposed model for the identification of mathematically gifted students fits our data. In order to evaluate model fit, three fit indices were computed: The chi-square to its degree of freedom ratio ($x^2/df$), the comparative fit index (CFI), and the root mean-square error of approximation (RMSEA) (Marcoulides & Schumacker, 1996). For the model to be confirmed, the values for CFI should be higher than 0.9, the observed values of $x^2/df$ should be less than 2 and the RMSEA values should be close to zero.

**Results**

In order to evaluate the construct validity of the model, a confirmatory factor analysis (CFA) was employed. CFA showed that all tasks and statements of the three instruments loaded adequately (i.e., they were statistically significant, because the $z$ values were greater than 1.96) on each factor (see Figure 1). Figure 1, presents the structural equation model with the latent and observed variables and their indicators. CFA also showed that the observed (students’ responses to each statement) and theoretical factor structures (the components of the theoretical model) matched the data set of the present study and determined the “goodness of fit” of the factor model ($CFI=0.914$, $x^2=554.630$, $df=341$, $x^2/df=1.626$, RMSEA=0.042). Therefore, the analysis suggests that the model could represent distinct factors across which students’ characteristics with respect to mathematics can be organised and should be considered during the identification of mathematically gifted students. Thus, students’ descriptions in regard to their (a) learning characteristics, (b) interests/curiosity, (c) creativity, (d) social-emotional characteristics and (e) mathematical reasoning are important for the identification of mathematically gifted students.

Students’ self-perceptions of their characteristics with regard to mathematics comprise of five factors (F1-F5) with statistically significant loadings; learning characteristics ($r=.898$, $p<.05$), interests/curiosity ($r=.734$, $p<.05$), creativity ($r=.891$, $p<.05$), social-emotional characteristics ($r=.998$, $p<.05$) mathematical reasoning ($r=.976$, $p<.05$). The data suggest that according to students’ responses for this age group, characteristics describing social-emotional characteristics and mathematical reasoning contribute more than learning characteristics, interests/curiosity and creativity to their self-perceptions.

In addition, the analysis revealed that the five types of mathematical abilities measured by the mathematical instrument constitute one general factor of mathematical ability (F7). Specifically, the statistically significant loadings of spatial abilities ($r=.312$, $p<.05$), quantitative abilities ($r=.665$, $p<.05$), qualitative abilities ($r=.626$, $p<.05$), inductive/deductive abilities ($r=.728$, $p<.05$), and causal abilities ($r=.467$, $p<.05$) show that
these abilities constitute general mathematical ability. The data suggest that for this age group the quantitative, qualitative and inductive/deductive abilities contribute more than the causal and spatial abilities to mathematical abilities. Likewise, the loadings of fluency (r=.836, p<.05), flexibility (r=.923, p<.05) and originality (r=.850, p<.05) suggest that these three first order factors constitute the second order factor of mathematical creativity (F6). Furthermore, one general factor, that of mathematical giftedness (F8), was generated from mathematical ability (r=.990, p<.05) and mathematical creativity (r=.672, p<.05) as shown by their statistically significant loadings.

The structure of the proposed model also addresses the self-report questionnaire’s ability to significantly predict students’ mathematical giftedness (r=.430, p<.05)

**Figure 1:** The structure of the proposed model.

**Discussion**

Initially, a theoretical model was conceived and it was later empirically tested and confirmed. Data analysis revealed that students’ responses to the self-report questionnaire can be organized across five distinct factors; (a) learning characteristics, (b) interests/curiosity, (c) creativity, (d) social-emotional characteristics and (e) mathematical reasoning. However, students are more aware of their social-emotional characteristics and those that refer to mathematical reasoning than learning characteristics, interests/curiosity and creativity.
Additionally, the findings confirmed that mathematical ability can be defined in terms of five abilities; spatial, quantitative, qualitative, causal and inductive/deductive abilities. Mathematical creativity can also be described in terms of fluency, flexibility and originality, as proposed by Torrance (1974). Moreover, the findings showed that mathematical ability and creativity constitute a more general factor, that of mathematical giftedness. Furthermore, data analysis revealed that students’ self-perceptions may predict mathematical giftedness. This is in accord with other researchers who claim that self-efficacy of gifted students contribute to the prediction of math performance (Pajares, 1996).

The findings imply that the self-report questionnaire reported in this study could be used as a means to collect information about mathematical giftedness, since it can predict mathematical abilities and creativity, aspects that have been acknowledged as components of mathematical giftedness (Renzulli, 1978). The self-report questionnaire addresses a variety of characteristics with a special emphasis in mathematics, complementing the lack of domain-specific identification instruments for gifted students, in the area of mathematics.

The proposed model can be useful to teachers, researchers and curriculum planners since it offers information on which aspects the identification of students’ mathematical strengths should be directed. Further research is required in order to introduce and examine additional instruments that might contribute to the identification of mathematical giftedness; still the data presented in this study are promising.

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**References**