The International Education Journal: Comparative Perspectives, 2012, 11(2), 45–62
ISSN 1443-1475

Assessing college student interest in math and/or computer science in a cross-national sample using classification and regression trees

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The purpose of this exploratory study was to assess the relative importance of a number of variables in predicting students' interest in math and/or computer science. Classification and regression trees (CART) were employed in the analysis of survey data collected from 276 college students enrolled in two U.S. and Greek universities. The results revealed that American students reporting high levels of barrier coping self-efficacy tended to show more interest in these fields. American students, however, with low barrier coping self-efficacy, low social or family influences, and low levels of self-efficacy for learning showed the least interest in math and/or computer science. In Greek students, the highest interest in math and/or computer science was observed among those whose parents had high expectations, expressed high barrier coping self-efficacy, and found mathematics to be useful. Overall, lower parental expectations and limited access to role models or mentors decreased their interest in these fields of study. Educational implications are discussed.

[Keywords: college students, classification and regression trees, math, computer sciences]

Many national reports such as *Rising Above the Gathering Storm* (National Academy of Sciences, 2007) and *Before It's Too Late* (National Commission on Mathematics and Science Teaching for the 21st Century, 2000) have stressed the rising demand for a workforce that possess a strong background in the areas of math and science. In fact, these reports stress that quality mathematics and science education play a critical role in preparing students to compete in a progressive global society. However, international comparisons show that student performance in the United States ranks much lower in math and science achievement (Hiebert et al., 2003) while attrition rates of college students majoring in these fields are troubling (Cavanagh, 2008). These issues raise a reasonable question pertaining to the factors that influence student interest and achievement in math and science.

Significant research evidence shows that contextual (parents, peers, and instructors) and personal cognitive variables (self-efficacy, goals and task value) may support or impede a student's decision to enroll and succeed in science courses (Lent, Lopez, & Bieschke, 1991; Lent et al., 2001; Lent, Brown, & Hackett, 1994; Steinmayr & Spinath, 2009). However, a limited number of studies have examined how different contextual variables interact with a variety of personal cognitive variables to influence students' interest in joining a mathematics or science field across different cultures (Chen & Lan, 1998; Chen & Zimmerman, 2007; Olszewski-Kubilus & Yasumoto, 1995). The purpose of this exploratory study is to examine the possible contribution of these variables as supports or barriers on students' interest in mathematics and/or computer science across two cultures, namely American and Greek college students using classification and regression trees (CART) (Breiman, Friedman, Olshen, & Stone, 1984).

Perceived barriers and supports influence the developmental trajectory of students, including their academic and career related choices (Lent, Brown, & Hackett, 2000). Some of the most studied barriers include gender (Albert & Luzzo, 1999; Brown & Josephs, 1999; Steele, James & Barnett, 2002; Yee & Eccles, 1988), cultural values and beliefs (Chen & Lan, 1998; Evans, Schweingruber & Stevenson, 2002; Hess, Chih-Mei, & McDevitt, 1987) and contextual barriers such as socioeconomic status, family, teachers, and peers (Ferry, Fouad & Smith, 2000; Ma, 2001, 2005; Chen & Zimmerman, 2007; McWhirter, 1997).

Gender has generally been conceptualized as a barrier in entering a mathematics field not only within a culture but also across cultures with boys overall showing more interest in math and science related subjects than girls (Evans et al., 2002). The findings of a recent study revealed that female students tend to report lower self-efficacy and math self-concept beliefs than male students, even when female students were enrolled in slightly higher level math courses and no prior achievement differences were found (Ferla, Valcke, & Cai, 2009). Correspondingly, teachers believe males to be inherently better at math than girls (Ernest, 1976) and parents consider that math is more difficult for their daughters than their sons (Yee & Eccles, 1988).

Other environmental sources that may impact students' decisions to pursue or to persist in the sciences include the social/cultural context, parents, teachers, and peers (Ferry, Fouad & Smith, 2000; Ma, 2001). For example, Evans et al. (2002) found that cultural differences exist, where boys from Japan were less likely to prefer math and science subjects than boys in the U.S. or Taiwan. Research studies also show that students whose parents have higher expectations of them in math classes and more advanced college expectations for them are more apt to take more advanced mathematics classes (Ma, 2001). Similarly, Brynes and Miller (2007) found that 58–81% of the variance in achievement was fully explained by family variables, specific opportunity (opportunities to practice a certain skill) and propensity factors (willingness to learn). Understanding the different barriers for entering a math or science fields such as computer science for male and female students, ethnicities, or cultures may be valuable in increasing and sustaining the interest, persistence, and achievement in those domains.

Within the context of this study, perceived supports were defined as different self-perceptions that offset the perceived barriers to mathematics and/or computer science interest. Factors such as student self-efficacy beliefs and perceived responsibility for learning may mediate the relationship between barriers and student interest in the sciences (Chen & Zimmerman, 2007; Bandura, 1986; Lent et al., 2001). Self-efficacy refers to the beliefs that an individual holds regarding his/her ability to perform a task (Bandura, 1986). In the present study, we examined two forms of efficacy: a) coping efficacy, which was defined as the degree to which students feel that they are able to cope with or manage difficult situations; and b) self-regulatory efficacy, which refers to how confident students were in their ability to effectively self-regulate themselves in various academic contexts (Zimmerman & Kitsantas, 2007). Studies show that self-regulatory efficacy and perceived responsibility (causal attributions that students make in terms of learning processes and outcomes) are positively correlated with academic achievement (Caprara et al., 2008; Zimmerman & Kitsantas, 2005). Given these findings, the aim of the present exploratory study is to identify how perceptions of supports and barriers interact to predict student interest in math and/or computer science in American and Greek students, separately, using CART analysis.

METHOD

Participants

We randomly recruited 380 students from mathematics and computer science courses in two public higher education institutions, one located in the U.S. and one in Greece. The overall response rate was 73.4% for the sample. Although 279 students responded to the questionnaires, 276 were used in the analyses as three questionnaires had a large number of questions unanswered. For the 276 surveys that were used in the analyses, we observed a small number of missing data for the variables we examined, ranging from 0.2 to 2.4%.

Both institutions offered equivalent courses and were located in cities although they were not comparable in terms of the population size. The U.S. student sample consisted of 46 females and 65 males whereas the Greek sample comprised of 75 females and 90 males. The American sample was diverse including 62% Caucasian, 3% Hispanic, 3% African American, 20% Asian, 8% Multi-Racial and 4% other. Within the Greek sample, 99% of the students were Greek. These students were primarily sophomores (86% sophomores and 14% juniors or seniors) majoring in mathematics and computer sciences. The mean age of the entire sample was 20 years, (M = 20, SD = 1.24), ranging from 17 to 32. Although the curriculum was comparable between the two universities, Greek students test in to specific majors as they attempt to enter college. In contrast, the American students have the option to declare their majors at a later point during their studies.

Measures

Personal data questionnaire. A short questionnaire was developed to obtain each participant's age, year in college, gender, ethnicity, major, and overall Grade Point Average (GPA).

Perceived responsibility for learning scale (PRLS) (Zimmerman & Kitsantas, 2005). This 20-item scale is designed to understand the students' perceived beliefs about who is responsible for different learning tasks and/or outcomes, themselves or the teacher. Sample items include, "Who is more responsible: for a student doing well on a test" and "Who is more responsible: for a student fooling around in class?" The responses range from 1–7, 1 (mainly the teacher), 2 (definitely the teacher), 3 (slightly the teacher) 4 (both teacher and student equally), 5 (slightly the student), 6 (definitely the student) and 7 (mainly the student). The lower the score the more the teacher was perceived as the responsible person for the student learning and the higher the score the more the students were perceived as responsible for their own learning. The reliability coefficient for this scale was a=.91 and for the present study was a=.87.

Self-efficacy for learning form (SELF) (Zimmerman & Kitsantas, 2007). This scale included 19 questions to measure students' sense of efficacy to perform a variety of academic tasks, such as, note taking, test taking, studying, understanding new concepts, time management, et cetera. Examples of questions are: "When you have trouble studying your class notes because they are incomplete or confusing, can you revise and rewrite them clearly after every lecture?" and "When you find yourself getting increasingly behind in a new course, can you increase your study time sufficiently to catch up?" The responses range from 0–100 in 10 unit increments. These increments are described as; 0–10% definitely cannot do it, 20–30% probably cannot, 40–60% maybe, 70–80% probably can and 90–100% definitely can do it. The higher the scale score, the more positive is the student's self-efficacy for learning beliefs. The inter item reliability coefficient for this scale was a=.93.

Math and/or computer science interest (Lent et al., 2001). This 15-item scale investigates students' interest in studying eight academic areas (that is, statistics, chemistry, physics, basic math, computer science, biology, advanced math and engineering). In addition, students indicate their degree of interest in performing seven activities related to those areas (that is, "solving practical math problems" and "learning new computer programs"). Responses were evaluated on a 5 point scale from strongly dislike to strongly like, higher scores representing strong interest an area. The scale has good construct validity with an alpha coefficient of .84 (Lent et al., 2001). Only the second subscale was used in the present study and the Cronbach's alpha based on these data was a=.85.

Contextual barriers and supports. (Lent et al. 2001). This survey assessed students' beliefs about social and family influences, financial constraints, instructional obstacles, and/or gender and racial biases that may result from their choice of a college major in math and/or computer science. The 36 situations described in this questionnaire were rated by the students on a 1 (not very likely) to a 5 (very likely) scale indicating the likelihood that they would experience the situations. Barriers (21 items) and supports (15 items) scores were totaled separately, higher scores indicating stronger negative or positive expectations of the possibility of the occurrence of the situations. Barrier items were organized into four categories including, *social or family influences*, *financial constraints, instructional, and gender and race discrimination*. A sample barrier item included, "Receive unfair treatment because of your gender". Support items were also organized into four categories: *social support & encouragement, instrumental assistance, access to role models or mentors, and financial resources.* An item representing support included, "Feel support for this decision from important people in your life (e.g. teachers)". In the Lent et al (2001) study the coefficient alpha was .90 for the barrier scale and .88 for the support scale. Similar Cronbach's alphas were obtained based on the present study, .91 and .87 respectively.

Barrier-coping efficacy. (Lent et al., 2001). Eighteen items assessed the students' confidence, as a math and/or computer science major, in their ability to cope with, or solve the situations described. The 10 point scale of measurement of one's ability to cope or solve the situations ranged from 0–2 (no confidence at all), 2–6 (some confidence) and 7–9 (complete confidence). The higher the score, the more confidence the student had in themselves in overcoming barriers. The situations included: "Deal successfully with competition among student in this field"; and "Succeed in a math and/or computer science related course despite having a poor instructor". The Lent, et al. coefficient alpha for this scale was .94. The Cronbach's alpha based on the present sample was .90.

Usefulness of mathematics scale. (Fennema & Sherman, 1976). This scale was adapted to measure students' beliefs about the importance of math and/or computer science in their lives and work in the future. The range for responses was from 1 (strongly disagree) to 5 (strongly agree). High scores indicate a greater belief that the subject areas are important to the student's future life and work. Examples of the items include: "I'll need mathematics and/or computer for my future work"; and "In terms of my adult life, it is not important for me to do well in mathematics and/or computer science." Based on the current study, the reliability for this scale was a=.89.

Parent expectations scale. This is an 11-item survey scale that was adapted from a questionnaire used by Ma (2001) to assess parent expectations for students enrolled in math and/or computer science courses. Parental expectations related to students doing well in coursework and completing various educational degrees were rated by the students on a five point scale ranging from 1 (strongly disagree) to 5 (strongly agree) through questions such as: "My parents expect me to complete a master's degree"; and "My parents think computer science is important". The higher the score, the more the students felt their parents thought of the importance of the item described. The Cronbach's alpha for this scale was .85 whereas based on the present study was a=.80.

PROCEDURE AND ANALYTICAL APPROACH

The data were analyzed using the CART software (Salford Systems, 2006). The CART methodology provides an alternative to parametric regression analysis. It is a nonparametric statistical tool and it can be used to uncover complex relationships between variables that cannot be detected by traditional statistical techniques such as ordinary least squares. Also, it deals effectively with a large number of variables and it is not affected by collinearities.

This tree-structured approach in regression was formalized by Breiman et al. (1984). A tree-structured predictor is designed to accurately predict the dependent variable and explain relationships that exist between the dependent and predictor variables. Prediction is achieved by recursively splitting the sample space into binary splits that lead to the formation of daughter nodes (nodes that can be split further) and terminal nodes (a node that cannot be divided any further). The main aspects of building a regression tree include: (1) the selection of a variable split at every daughter node by applying a goodness-of-split criterion that determines the reduction in impurity or variation; (2) a pruning procedure which produces a sequence of sub-trees from which an optimal tree is selected; and (3) cross-validation which measures the goodness-of-fit of the final tree. The algorithm produces terminal nodes that internally are more homogeneous than the parent nodes. The tree building process stops when all observations at each terminal node have a very similar distribution as it relates to the predictor variables or if an external limit has been placed in the number of cases that should be in each terminal node. We did not place an external limit in the sample size that should be assigned to the terminal nodes due to the exploratory nature of this study.

CART computes the mean and standard deviation of the dependent variable and these measures are assigned to each daughter and terminal node of the regression tree. The mean value becomes the predicted value of the dependent variable. Cross-validation is used to measure the goodness of fit of the final tree. In cross-validation, the data set is randomly split into a number of subsets. One of these subsets of data is used as an independent test sample to validate the tree, while the other N-1 subsets are used to build the tree. The entire tree-building procedure is replicated numerous times. For instance, in a 10-fold cross validation, the data are divided into 10 equal subsets. In each cross-validation replication, nine of the subsets are used to build the tree and one is used as a test sample to test the accuracy of the tree.

This method is well suited for this study as we aim to profile students who are likely to show interest in mathematics and/or computer science fields based on a large number of predictor variables. Two regression tree models were built separately for the American and Greek college students using the CART software (Salford Systems, 2006). These separate analyses allowed us to evaluate differences that may exist in the variables that predict interest in math and/or computer science across students with diverse cultural backgrounds.

RESULTS

Descriptive information of the variables is presented in Table 1. Significant differences emerged between the two samples for most of the variables. t-test results showed that American students generally held stronger perceived responsibility for learning ($t(274) = -4.69$, $p < .001$), interest in mathematics and/or computer science ($t(274) = -2.83$, $p < .01$), as well as perceived math and/or computer science support ($t(274) = -3.92$, $p < .001$). In terms of the specific types of support, American students reported higher levels of instrumental assistance ($t(274) = -3.94$, $p < .001$), access to role models or mentors ($t(274) = -3.60$, $p < .001$), and financial resources ($t(274) = -6.15$, $p < .001$) than Greek students. Finally, American students were more likely than Greek students to report higher levels of barrier-coping efficacy ($t(274) = -4.93$, $p < .001$) as well as higher levels of parental expectations ($t(274) = -5.13$, $p < .001$) and usefulness of mathematics ($t(274) = -9.44$, $p < .001$). Greek students, however, reported higher levels of self-efficacy for learning ($t(274) = 17.78$, $p < .001$) in addition to higher levels of perceived math and/or computer science barriers ($t(274) = 4.53$, $p < .001$) than American students. In terms of the specific perceived barriers, Greek students reported higher levels of social or family influences ($t(274) = 2.41$, $p < .05$), financial constraints ($t(274) = 3.63$, $p < .001$), and instructional barriers ($t(274) = 7.64$, $p < .001$) than American students. No differences between the two samples were detected in contextual barriers and supports, social support and encouragement, gender and race discrimination, and GPA.

Figures 1 and 2 depict the optimum regression trees for predicting interest in math and/or computer science related fields among American and Greek students, respectively. Each tree consists of the root node which contains the entire sample and provides information about the average score of interest in math and/or computer science and standard deviation. The terminal nodes present the same information with the exception that the standard deviation is expected to be reduced as the nodes become more homogeneous compared to the root node which contains the entire sample size.

American Students

The overall mean in interest in math and/or computer science for the American students was 3.32 with a standard deviation of 0.71. Figure 1 shows the regression tree built for this group. The primary variable splitter was barrier of coping self-efficacy. Other variables which were important in predicting interest in math and/or computer science included gender, social or family influences, perceived responsibility for learning, and self-efficacy for learning. The selection of these variables explained approximately

52% (R^2, coefficient of determination) of the variation in math and/or computer science interest. Profiles of those with a high and low interest in these fields are summarized below.

American female students with high levels of barrier coping self-efficacy techniques showed the highest interest in these study fields (*M* = 3.77, terminal node 6). The average interest in math and/or computer science among students with these characteristics increased by 12% in comparison to the overall average of math and/or computer science interest observed for the entire sample (*M* = 3.32). Males with high barrier coping self-efficacy techniques who believed that the student is not responsible for learning (lower levels of perceived responsibility) showed a slight increase (2% increase) in interest (*M* = 3.37, terminal node 4). Male students, however, who believed that the student is responsible for his/her own learning (higher levels of perceived responsibility) were associated with lower interest in math and/or computer science (*M* = 2.02, terminal node 5). Relative to the average interest in math and/or computer science for the entire sample, there was a 40% decrease in this group that consisted of only three cases.

Overall, American students with lower barrier coping self-efficacy techniques were less likely to report interest in math and/or computer science. For instance, students with low barrier coping self-efficacy techniques, low social or family influences and low levels of self-efficacy for learning were less interested in these fields (*M* = 2.61, terminal node 1). This combination of these characteristics lowered student interest in math and/or computer science by approximately 22% relative to the average interest for the entire sample. The interest increased for students with the same characteristics but with higher self-efficacy for learning levels (*M* = 3.23, terminal node 2). A smaller subgroup of students in size (n = 5) with low barrier coping self-efficacy techniques and high levels of social or family influences also showed a limited interest in math and/or computer science (*M* = 2.16, terminal node 3).

Table 2 displays a descriptive summary of the variable splits selected by the regression tree for this sample. We notice that those with higher interest in math and/or computer science tend to have higher barrier-coping efficacy and self-efficacy for learning. Social or family influences are lower among those with high interest in math and/or computer science while no clear pattern emerged for perceived responsibility for learning.

Greek students

On average Greek students expressed less interest in math and/or computer science (*M* = 3.08, *SD* = 0.70) compared to their American counterparts. Figure 2 presents a six terminal node tree with the primary splitter variable being at parental expectations. Other variables which were important in predicting interest in math and/or computer science included access to role models or mentors, barrier coping self-efficacy techniques, usefulness of mathematics and GPA. The selection of these variables explains approximately 63% of the variation in math and/or computer science interest. Profiles of those with a high and low interest in these fields are summarized below.

In Greek students, the highest interest in math and/or computer science was observed among those whose parents had high expectations, expressed high barrier coping self-efficacy techniques and found mathematics to be useful (M = 3.68, terminal node 6). There was an increase of 20% in interest in math and/or computer science among students with these characteristics compared to the entire sample (M = 3.08, root node). Another subgroup with high interest had parents with high expectations, high barrier coping self-efficacy, and although did not consider math to be as useful had a high GPA (M = 3.32, terminal node 5). A lower GPA, however, within this subgroup was associated with a 12% decrease in interest (M = 2.74, terminal node 4).

Overall, lower parental expectations and limited access to role models or mentors decreased student interest in math and/or computer science by about 22% relative to the average interest for the entire sample (M = 2.42, terminal node 1). Access to role models or mentors improved their interest slightly (M = 2.95, terminal node 2). Low barrier coping self-efficacy techniques in individuals with high parental expectations were also associated with lower levels of interest (M = 2.94, terminal node 3).

Table 3 displays a descriptive summary of the variable splits selected by the regression tree for the Greek sample. Overall, we found Greek students with high interest in math and/or computer science to have parents with high expectations, access to role models or mentors, high scores for usefulness of mathematics and in barrier-coping efficacy. Also, those with high interest in math and/or computer science tended to have higher GPA.

DISCUSSION

The findings of the present study align with previous research which suggest that students do not make choices about courses in isolation, rather, they are influenced by the expectations of the adults in their lives (Bandura, 1986), the beliefs and practices of their cultural influences and the expectations for their gender roles (Eccles, 1994). CART, which allowed us to profile students who are likely to show an interest in math and/or computer science courses, revealed that parental expectations were the strongest predictor of interest in mathematics and/or computer science in Greek students while perceived self-efficacy to cope with barriers was the most potent predictor for the American students. This indicates that interest in college level mathematics and/or computer science courses for Greek students may be highly influenced by parental expectations while American students are mainly influenced by their own beliefs about their ability to cope with the barriers.

Furthermore, the next most important predictor of interest in mathematics and/or computer science was access to role models or mentors and barrier coping self-efficacy for the Greek students as compared to gender and social or family influences for the American students. This finding may also reflect that more social and gender issues are present in the American culture than the Greek culture, especially considering the heterogeneous nature of the US population as opposed to the homogenous make up in terms of race and ethnicity of the Greek population. Gender was a predictor of interest for the American sample but not for the Greek sample. This is inconsistent with other studies suggesting that gender can be a barrier across different cultures (Evans et al., 2002).

For the American students, self-regulatory efficacy and social or family influences were important in the context of lower levels of perceived coping self-efficacy. More specifically, students with lower levels of barrier coping self-efficacy who reported that they were influenced less by their social or family environment and had lower levels of self-regulatory efficacy were less interested in math and/or computer science courses. These findings are consistent with the findings of Caprara et al. (2008) who found higher levels of self-regulatory efficacy to be associated with higher academic achievement. Furthermore, consistent with Bandura (1997) and Lent's et al. (2000) findings, American female students who felt efficacious in their ability to cope with barriers showed the greatest interest in mathematics and/or computer science. Conversely, males who reported high perceived responsibility were less likely to be interested in math and/or computer science.

For the Greek sample, a high interest in mathematics and/or computer science was also evident among students whose parents had high expectations and more frequently used barrier coping self-efficacy strategies. However, they did not believe that mathematics was useful and continued to achieve high academically. This suggests that perceptions of usefulness of mathematics may not be as important as higher parental expectations and barrier coping self-efficacy strategies. GPA was important in the context of those with lower levels of usefulness of mathematics. Specifically, Greek students with a high GPA were more likely to be interested in math and/or computer science even if they did not find mathematics and/or computer science as useful. Furthermore, for Greek students, access to role models or mentors was important in the context of lower parental expectations. This shows that if parents had lower expectations, these students would try to locate role models and the presence of these role models was likely to increase their interest in math and/or computer science.

- Limitations of the present study may include the fact that these students were already majoring in mathematics and/or computer science, the relatively small sample size, and fatigue effects from multiple instruments administered. In addition, the data collected were self-reported including student GPA. Limitations related to CART include the non-probabilistic nature of this methodology. Only means and standard deviations are computed for the outcome variable without confidence intervals that could provide information about the overall accuracy of these estimates. An additional limitation of CART includes the complexity of the trees produced. Complex (containing a large number of nodes) trees can be difficult to interpret. Further, it should be noted that CART is an exploratory method and it would be most appropriate to confirm the present findings by using this methodology with larger samples while examining similar research questions. Therefore, these findings cannot be generalized to wider populations. Despite these limitations, the findings of the present study are important for generating new research hypotheses, extracting underlying factors to be tested further, developing parsimonious models, and considering new statistical tools for testing these hypotheses/models. Further, several educational implications can be derived from this study.

EDUCATIONAL IMPLICATIONS

Although several differences exist between the two samples of Greek and American students in regards to predictors of math and/or computer science interest, high levels of barrier coping self-efficacy techniques were associated with an increased interest in math and/or computer science in both groups (and in particular, US females). This finding has several implications for students who are less interested in majoring in math and/or computer science fields. First, professional development programs geared toward math and/or computer science instructors should be designed to build and promote barrier coping self-efficacy techniques in students. Furthermore, educational interventions targeting parents, as early as in elementary school, should be designed to guide parents in helping equip their children with more coping strategies and enhance their self-efficacy beliefs to deal with barriers. These efforts may not only increase interest in math and/or computer science but also encourage retention of math and/or computer science students and, in particular, females. The more confident the students are in themselves in overcoming barriers related to math and/or computer science the more likely they will continue their studies or enter these fields.

Second, since access to role models or mentors was associated with higher interest in the sciences, students need to be exposed to role models-mentors who have successful careers in the math and/or computer science fields. Opportunities to work with and observe mathematicians and scientists early in their studies may influence students' decision to enter these fields. At the same time, students can benefit by having faculty advisors/role models that can make them aware of career opportunities that exist in these fields.

Third, another implication of the present study is based upon differences between Greek and American students in regards to predictors of interest in math and/or computer science fields. Given the findings of this study where different constellations of predictors may increase interest in math and/or computer science across these two ethnic groups, and the population diversity in the US, interventions should be designed with cultural differences in mind. Cultural differences in beliefs about math and/or computer science education should be taken into consideration when interventions are designed to increase students' interest in math these sciences.

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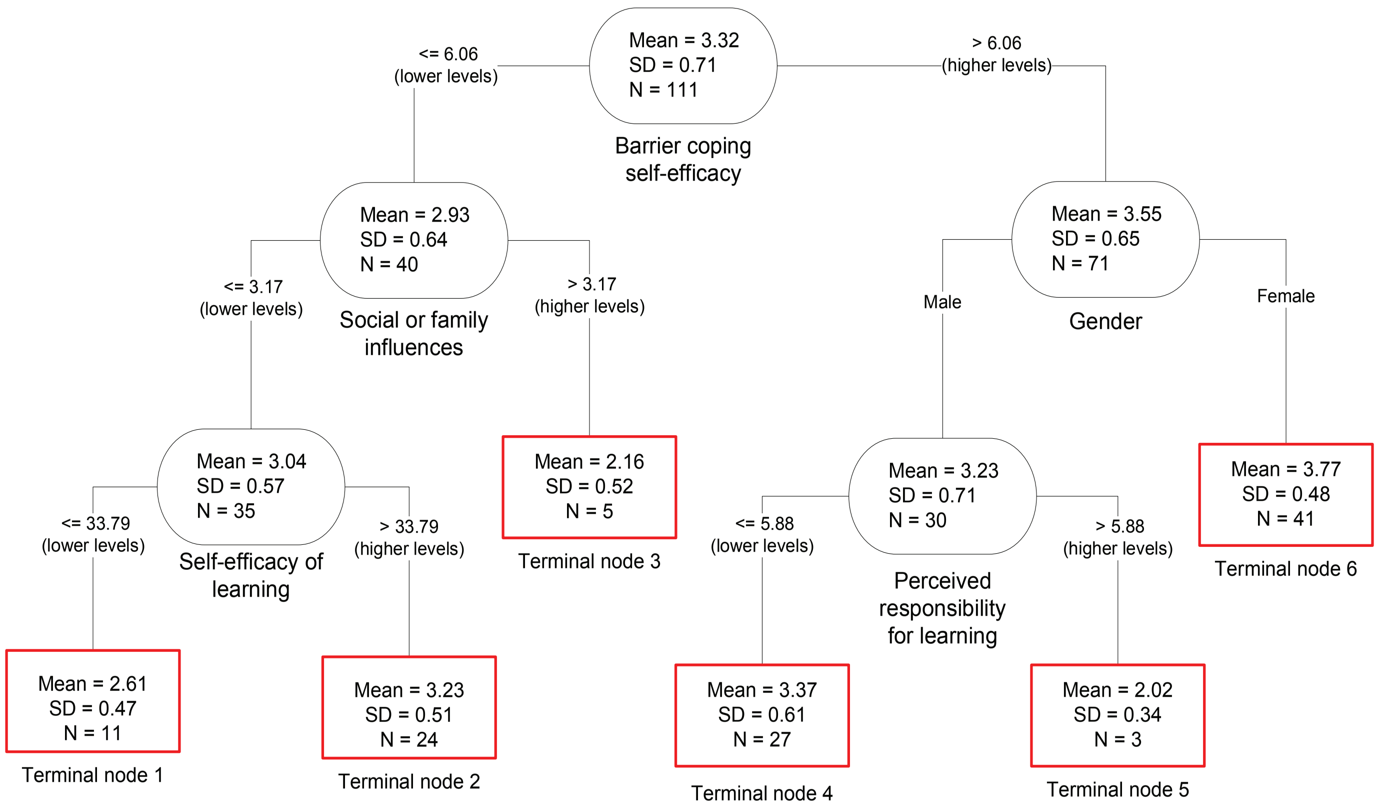
Table 1 Descriptive information of outcome and predictor variables

Variable	Greek		American			
	M	SD	M	SD	t	p
1. Perceived responsibility for learning scale	4.84	0.61	5.21	0.67	-4.69	.001
2. Self-efficacy for learning	56.64	9.44	37.28	8.47	17.78	.001
3. Math and/or computer science interest	3.08	0.70	3.32	0.71	-2.83	.01
4. Contextual barriers and supports	2.81	0.35	2.79	0.37	0.54	.59
4a. Perceived math and/or computer science supports	3.38	0.58	3.68	0.64	-3.92	.001
4a1. Social support & encouragement	3.99	0.72	3.96	0.66	0.33	.75
4a2. Instrumental assistance	3.08	0.94	3.53	0.91	-3.94	.001
4a3. Access to role models or mentors	3.15	0.83	3.50	0.79	-3.60	.001
4a4. Financial resources	2.80	0.81	3.49	0.97	-6.15	.001
4b. Perceived math and/or computer science barriers	2.38	0.54	2.07	0.57	4.53	.001
4b1. Social or family influences	2.34	0.57	2.15	0.66	2.41	.05
4b2. Financial constraints	2.75	0.89	2.34	0.92	3.63	.001
4b3. Instructional barriers	2.95	0.85	2.21	0.71	7.64	.001
4b4. Gender or race discrimination	1.75	0.74	1.65	0.59	1.23	.22
5. Barrier-coping efficacy	5.48	1.32	6.35	1.49	-4.93	.001
6. Usefulness of mathematics	2.78	0.33	3.17	0.33	-9.44	.01
7. Parental expectations	3.50	0.57	3.87	0.59	-5.13	.001
8. GPA	3.01	0.59	3.16	0.73	1.33	.78

Figure 1. **Regression Tree for American Students. The mean and standard deviation (SD) in each node indicate the average interest in math and/or computer science.**



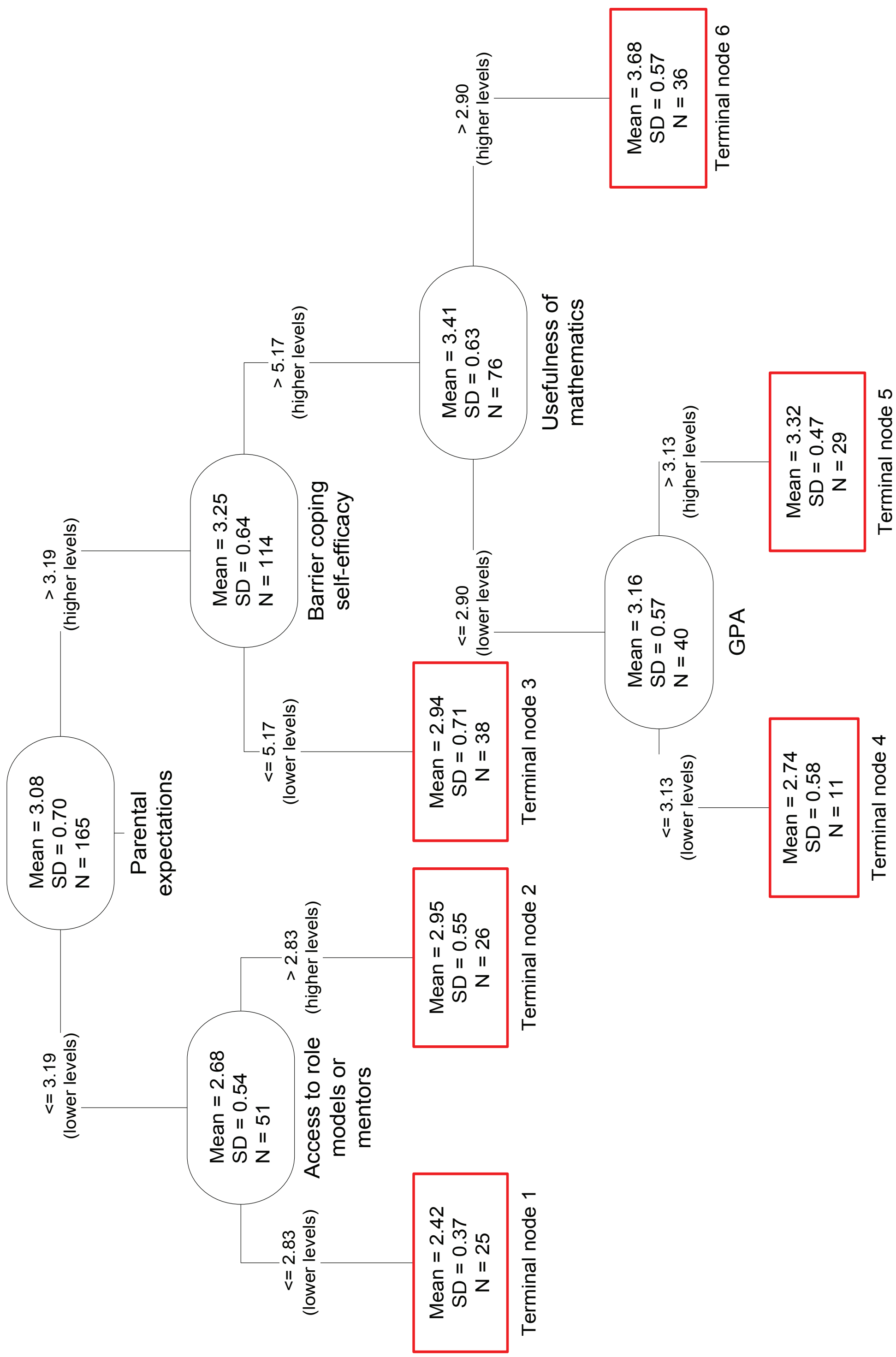


***Figure 2*. Regression tree for the Greek students. The mean and standard deviation (SD) in each node indicate the average interest in math and/or computer science.**

Table 2. Selected characteristics (%, mean and SD) of American students at each terminal node or subgroups of the regression tree presented in figure 1.

Characteristics	Terminal Node Groups					
	1	**2**	**3**	**4**	**5**	**6**
Total N	11	24	5	27	3	41
Math and/or computer science interest	2.61 (0.47)	3.23 (0.51)	2.16 (0.52)	3.37 (0.61)	2.02 (0.34)	3.77 (0.48)
Barrier-coping efficacy	4.70 (0.93)	5.04 (1.23)	4.42 (1.09)	7.09 (0.77)	6.50 (0.92)	7.38 (0.70)
Social or family influences	2.32 (0.53)	2.21 (0.59)	3.53 (0.38)	2.04 (0.63)	1.88 (0.13)	2.00 (0.55)
Gender						
Male (%)	18.2	66.7	60.0	100	100	0.0
Female (%)	81.8	33.3	40.0	0.0	0.0	100
Perceived responsibility for learning	5.07 (0.51)	5.37 (0.75)	4.89 (0.26)	4.94 (0.74)	6.15 (0.16)	5.41 (0.42)
Self-efficacy for learning	30.8 (4.68)	38.3 (6.94)	32.5 (6.26)	35.8 (4.44)	32.2 (5.9)	41.5 (8.44)

Table 3. Selected characteristics (mean and SD) of Greek students at each terminal node or subgroups of the regression tree presented in figure 2.

Characteristics	Terminal Node Groups					
	1	**2**	**3**	**4**	**5**	**6**
Total N	25	26	38	11	29	36
Math and/or computer science interest	2.42 (0.37)	2.95 (0.55)	2.94 (0.71)	2.74 (0.58)	3.32 (0.47)	3.68 (0.57)
Parental expectations	2.79 (0.28)	2.89 (0.31)	3.73 (0.37)	3.68 (0.34)	3.78 (0.42)	3.92 (0.37)
Access to role models or mentors	2.30 (0.28)	3.55 (0.48)	2.84 (0.74)	3.15 (0.98)	3.42 (0.75)	3.46 (0.89)
Barrier-coping efficacy	4.98 (1.46)	4.98 (1.17)	4.26 (0.63)	6.46 (0.73)	6.59 (0.79)	6.32 (0.87)
Usefulness of mathematics	2.67 (0.28)	2.77 (0.28)	2.82 (0.30)	2.49 (0.19)	2.52 (0.29)	3.13 (0.14)
GPA	3.01 (0.43)	3.03 (0.49)	3.24 (0.76)	2.96 (0.15)	3.68 (0.39)	3.41 (0.60)