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Factors Associated with the Development of Secondary School Students' Interest towards STEM Studies

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Abstract: The aim of this study is to investigate the predictive factors that predispose secondary school students' interest in studying STEM (Science, Technology, Engineering, and Mathematics) fields in higher education. For this purpose, an already existing questionnaire was used and modified properly, according to the Greek educational system. The survey was attended by 301 secondary school students, who study in Piraeus, one of the largest cities in Greece. Research findings indicated that the principles of Social Cognitive Career Theory (SCCT) are well supported. It is worth mentioning that this is the first time that such a number of variables had been examined, in order to support the SCCT. In particular, very few studies exist in literature—to the best of our knowledge—investigating the effect of more than four factors influencing students' interest towards STEM higher studies. Learning experiences, students' exposure to STEM activities within the school environment and outside of it (OR = 0.071, p = 0.002), as well as their involvement with high difficulty STEM courses (OR = 0.203, p = 0.038), appear to be positively correlated with the development of interest towards studies in the STEM fields. In addition, students from low-income families are more likely to follow STEM studies (OR = 0.198, p = 0.034). On the contrary, it has been revealed that parental educational background only supports the student's decision to continue studies after high school, without specifying the educational field in higher education (OR = 0.769, p = 0.703; father's educational level, OR = 0.698, p = 0.552; mother's educational level). Data revealed that outcome expectations and self-efficacy (OR = 14.366, p = 0.005) are positively related to the procedure of students' interest development to pursue STEM fields in higher education, while gender seems to be a non-regulatory factor (OR = 0.886, p = 0.831).

Keywords: Social Cognitive Career Theory (SCCT); STEM activities; self-efficacy; motivation movement; learning experiences

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1. Introduction

Social Cognitive Career Theory (SCCT) is an important conceptual and theoretical scheme that supports the holistic study and exploration of those factors that act in the cognitive process of making educational and professional decisions. The theory was founded and formulated by Lent, Brown, and Hackett [1–3]. According to researchers, the contribution of individual and intra-patient situations to the successful outcome of requirements linked to external situations should be seriously considered and inextricably linked to the expectation of a result or "self-efficacy". The term "self-efficacy" was first introduced by A. Bandura, who mentioned it in many studies, including that of the Social Learning Theory [4–10]. However, many investigations about "self-efficacy" have also been performed by other researchers [11,12]. The meaning of "self-efficacy" or "self-efficacy expectation" can be also looked up in Social Cognitive Theory of Behavior [13,14], which assesses the person's ability to define himself (human agency). Bandura's theory emphasizes indirect learning (vicarious learning), which is the learning that occurs by observing others. Simultaneously, that type of learning can lead to the development of the

socio-cognitive mechanisms of an individual, in order to regulate their behavior for future success or performance.

The main point that differentiates SCCT from other models of professional development is the emphasis on the existence and functioning of social-cognitive mechanisms as determinants of human behavior. Based on other professional development models, a person's behavior is considered to be a derivative of the interaction between the person and the environment. In SCCT, however, human behavior is also considered as a co-modifier of the environment. Hence, SCCT adopts the triadic reciprocal model of causality of A. Bandura [15], whereby the cognitive and environmental factors, as well as the manifest behavior of a person, constitute mechanisms that interact dynamically with each other by influencing each other.

The theory in the first part focuses on the cognitive factors that are supposed to shape both the professional interests and choices and the consequent performance. Nevertheless, it is reasonable that human actions do not take place in an environmental vacuum. For this reason, in the second part of the theory, the rapporteurs deal with the role of individual and environmental factors. Therefore, for the SCCT's rapporteurs, an individual's professional development "is a picture of theatrical drama that" rises "on the social stage" [1]. In this context, personal, environmental, and learning factors are highlighted, acting as crucial contributions to the individual's career path. Through these factors, the central cognitive mechanisms (such as self-efficacy perceptions and outcome expectations) as well as the individual's consequent professional development are being shaped. [2]. It is noteworthy that SCCT is also influenced by other academic and occupational behavior models [16–18], as well as by Vroom's Expectation Theory [19] and Locke [20] and Locke and Latham's Goals Setting Theory [21]. In addition, it is inspired by theories that focus on the influence either of environmental factors [22,23] or genetic factors on behavior and personality [24,25]. Researchers' findings [11,26–29] have shown that the relationship between self-perceptions of mathematics, technology, and science with gender, educational, and professional aspirations and choices has been investigated in students in the aforementioned STEM fields. SCCT has been applied to a wide range of studies related to STEM education at school [25,30,31]. Moreover, SCCT has been applied to students, in order to predict their interest both in STEM education and STEM career choice [25,32].

In Greece, Secondary Education is provided in two cycles: Compulsory Secondary Education offered by "Gymnasium" and Post-secondary Secondary Education provided by the "Unified High Schools" and "Technical Vocational" Schools. It should be noticed that "Gymnasium" consists of three grades with total duration of three years, corresponding to the 7th, 8th, and 9th grade. The curriculum consists of General Education courses, which are the same for all the students.

It should also be noticed that the "Unified High School" consists of three grades with a total duration of three years. In the 1st grade of the "Unified High School", which corresponds to the 10th grade of the international educational system, the curriculum consists of General Education courses, which are the same for all the students. In the 2nd grade of the "Unified High School" (11th grade), students have to choose one of the two following directions: "Theoretical" or "Positive". During this grade, students are taught both general and directional education courses. "Positive" direction courses include Mathematics and Physics. Finally, in the 3rd grade (12th grade) of the "Unified High School", students have to choose one of the following directions: Humanitarian Sciences, Positive Sciences, and Economics. The courses of "Positive" direction are Mathematics, Physics, Chemistry, and Biology. Students of the Economic Cycle are also taught Economics and Informatics.

In our research model the main six variables studied, according to SCCT, are gender, family background, learning experiences, self-efficacy, outcome expectations, and social support. Our findings confirm that the principles of SCCT are well supported. Limited studies exist in literature—to the best of our knowledge—which study the effect of more than four factors influencing students' interest towards STEM higher studies.

2. SCCT Predicting Factors of Students' Interest in Higher STEM Education

The main six variables, which predict students' interest in higher STEM education are represented below. In this study, it is clarified that higher education is considered to be the attendance at an academic institution, such as a University or a College, leading to the acquisition of a degree or diploma. Additionally, fields such as Medicine, Mathematics, Physics, Chemistry, Biology, Statistics, Computer Science, Agricultural, Engineering Sciences, and Architecture were defined as STEM fields.

Gender: Several surveys have shown a high level of self-efficacy for men both for traditional males' and females' work. For female students, however, high levels of self-efficacy have been noted solely for female occupations [12,33]. Other researchers have demonstrated that different gender socialization contributes to the creation of differential perceptions of self-efficacy and, consequently, different perceptions for career choices [34–36]. Further studies have pointed out that the effect of gender on professional development stems from both personal physiological skills and the degree of acceptance by the socio-economic context [2]. Following the same theoretical basis, the concepts of self-efficacy in Science and Mathematics were explored. Within this framework, it was revealed an influence of gender, both on interests and the choices for studying in STEM fields and justified the under-representation of women in these specific cognitive fields [37,38]. In 2001, Bandura and his colleagues [14], have shown that self-efficacy perceptions differ in terms of gender. Boys have a high level of self-efficacy perceptions for male occupations in science and technology, while girls for women activities, like social and educational ones [39].

Rollins and Valdez's recent surveys [40] on a group of adolescent pupils in terms of gender and socio-economic backgrounds, demonstrated higher levels of girls' self-efficacy perceptions for the educational and professional decision-making process for "traditional" female professions (i.e., music and social sciences). Additionally, Williams and Subich [41] discovered that men reported greater access to information on realistic and research-based professional occupations, whereas women were mainly interested in Social Sciences careers, along with a great lack of interest in Mechanics [42,43].

Family background: Since the socio-economic background of the family belongs to the environmental factors and in particular to the contextual affordances, it precedes and formulates both educational and socio-cognitive mechanisms. Children of higher socio-economic background feel more comfortable with the selection process [44,45]. The higher the socio-economic level, the higher the aspirations of young people and their academic achievements [34,46–49]. Research data on Asian, African American, and Latin American adolescents have shown that the cultural atmosphere at home and the parental educational level play a key role in the professional preferences of young people [37,50]. Low socio-economic status, as a restrictive factor in the educational and professional decision-making process, is apparent, as denoted in several studies [1,51,52]. In particular, students from low socio-economic level were less interested in studying in STEM fields than their counterparts from higher socio-economic levels. However, students' educational achievements reverse the aforementioned socio-economic difference [53].

Recent research has shown that working-class children pay attention to the external characteristics of study and work (professional opportunities, remuneration), while children of senior social classes have a more internalized perception of work [54]. Based on the fact that the former ones pay particular attention to the outcome expectations of studies and work [55], it is more possible to express greater interest in studying STEM fields than the latter ones. Similar results are also observed in the research of Jackson and Lichtenberg [56], as well as Lichtenberg and Jackson [57], on the basis that economically disadvantaged students are more confident in dealing with STEM fields. Finally, the study by Chachashvili-Bolotin et al. [58] indicates that the higher the students' perception of their family financial background, the lower their interest in studying in STEM fields in higher education.

Learning experiences: A body of evidence has demonstrated that the exposure of students to STEM activities and programs concurrently into and outside the school environment strengthens their interest in STEM studies in higher education [59,60]. In addition, their engagement with STEM extra classroom activities helps them better understand these processes [61]. Indeed, the younger an individual is exposed to these actions, the more likely it is for them to make a STEM career choice [62,63]. Further studies have demonstrated similar findings [59]. Students' educational achievements in mathematics seem to be related to their future engagement in studying STEM fields and pursuing a STEM career [25]. Although educational achievements in mathematics were considered to be one of the main predictors of STEM studies in higher education, further data have established that exposure to natural sciences is more decisive for future enrolment in STEM fields [25].

Self-efficacy: The term "self-efficacy" was introduced by A. Bandura in 1986 [15] and is considered as the subjective judgments and perceptions of an individual's abilities, in order to successfully fulfill a task. Apart from personal beliefs, however, self-efficacy also includes all the actions need to be followed by the subject for a successful outcome (response outcome expectation), as well as the results of these actions. Self-efficacy plays a key role in the development of interests, ambitions, choices, and aspirations [64–66], which are fundamental factors for a certain behavior and performance [13–15,67,68].

Outcome expectations: Future positive profits of a particular choice will mobilize students towards a specific behavior, resulting in a certain outcome expectation. For instance, studying in STEM fields has been considered to be related to future professional opportunities, higher income, and well-respected social status [25].

Social support: Regarding the environmental mechanisms that function supportively, these are specific situations or environmental sources that facilitate the formulation of the individual and their effort to achieve their professional goals [1]. Examples of such mechanisms are financial support, the encouragement by important people in the family or friends, or interaction with people who can act as mentors in the life of the individual.

Based on the aforementioned theoretical framework, in this research the variables that were examined are gender corresponding to student's personal data; the student's socio-economic level; and the student's social perceived support by direct and indirect social environment. These belong to the environmental factors and particularly contextual affordances; outcome expectations and self-efficacy (belonging to the cognitive mechanisms of the individual); as well as learning experiences (student's exposure to STEM programs and/or activities in and out of school, student's achievements, and/or performance at school when involved in STEM courses).

Research Question

Based on the above, the research design was realized in such way as to answer the following research question:

What are the SCCT-based factors that are able to predict secondary students' interest in pursuing STEM fields in higher education?

3. Materials and Methods

We employed a self-designed questionnaire to measure the factors that are able to predict secondary students' interest in pursuing STEM fields in higher education. The questionnaire included 11 questions regarding students' attitudes towards higher education, 7 questions regarding students' knowledge about higher education, 8 questions about personal information, and 5 questions about information regarding students' background. The reliability coefficient Cronbach's alpha was 0.598.

The sampling method applied in this study was convenience sampling. Prior to completing the survey, approval from the school principals was obtained. The potential participants were contacted during their regular school classes and were informed of the purpose of the study and the time demands. They were further informed that their responses would remain confidential and that their participation could be revoked at any time. Our survey was attended by 301 secondary school students, who study in eight

Public Secondary Schools of Piraeus from 8th to 10th grade. 50.17% of the participants were boys, aged 14–16 years old. The study was conducted between September 2019 and November 2019, within the regular school schedule. The time needed to complete the survey was approximately 30–35 min.

Input Variables: Table 1 presents the main variables of the study. The dependent and independent variables are described in detail below.

Table 1. Description of input variables in the study.

Input Variables	
Dependent Variable	1. How important in your view is pursuing higher education? 2. Disregarding your school grades, what is the area of study you would be interested to study in higher education?
Independent Variables	1 Gender 2. Family background assessed via parents' educational level and students' perception of the family economic background 3. Learning experiences: 3.1 Student's school performance in mathematics 3.2 Student's involvement in courses related to STEM education 3.3 Student's exposure to STEM activities and programs both in and outside of the school environment 4. Self-efficacy 5. Outcome expectations 6. Student's social support

Dependent variable

The dependent variable is the interest of secondary school students in studying STEM fields in higher education. This variable was measured through the following two questions:

(1) *How important in your view is pursuing higher education?* (see question 1 in Appendix A)
(2) *Disregarding your school grades, what is the area of study you would be interested to study in higher education?* (see question 4a in Appendix A). Based on the answers to these two questions, the following three categories of students were distinguished:

1—I am not interested in studying at an academic institution, 2—I am interested in studying at an academic institution, but not related to a STEM field, and 3—I am interested in studying at an academic institution that is related to a STEM field.

Independent Variables

The independent variables considered were gender, family background (assessed through mother's and father's educational level and the students' perception of the family economic background), learning experiences, self-efficacy, outcome expectations, and student's social support. Specifically:

Student's school performance in mathematics: a number of studies have shown that students' high performance in mathematics is positively related to study in STEM fields [25]. In addition, the score in mathematics is of key importance for applicants, in order to be accepted into Technical Schools, Mathematics, and Natural Sciences. The questions are the following:

(1) *How much difficulty would you say that you have in attending mathematics in the school environment?* (see question No. 23a of Appendix A)
(2) *What is your average score in Mathematics?* (see question No. 24a of Appendix A). The variable was then divided into three categories, (a) low performance (below 59), (b) moderate performance (between 60–79), and (c) high performance (between 80–100).

Student's involvement in courses related to STEM education such as Physics, Chemistry, Biology, and Computer Studies: the student's involvement in the above-mentioned courses was measured by the following questions:

(1) *How much difficulty would you say that you have in attending Physics, Chemistry, Biology, and Computer Studies?*
(2) *What is your average score in Physics, Chemistry, Biology, and Computer Studies?* (see question No. 24b,c,d,e of Appendix A). The variable was then divided into three categories, (a) low performance (below 59), (b) moderate performance (between 60–79), and (c) high performance (between 80–100).

Student's exposure to STEM activities and programs both in and out of the school environment: Students who have visited STEM academic institutions, attended STEM programs and/or clubs, or have taken private courses in STEM fields, were categorized into one analysis group, while those who were not exposed were categorized into another one. The questions related to this variable included:

(1) *Have you ever visited an Academic Institution during your school visits?* (see question No. 11 of Appendix A). If the answer to this question is positive the students are required to clarify the institution with the following question:
(2) *Which one/ones?* (see question No. 12 of Appendix A). The student is invited to select the institution they had visited from a list of academic institutions. Then, the selection was categorized into STEM or non-STEM field. By definition, institutions like the National Technical University of Athens, the Department of Positive Studies of the University of Athens (UoA), the Department of Informatics of UoA, the Medical and Pharmacy School of UoA, the Agricultural University of Athens, and the University of Piraeus were considered to be STEM institutions (answers 1-2-3-4-5-9 of question No. 12 of Appendix A) The other alternatives (answers 6-7-8-10 of question 12 of Appendix A) were considered as non-STEM institutions. Then, the variable was split into three categories: (a) they have not visited any higher academic institution, (b) they have not visited a STEM higher academic institution, and (c) they have visited a STEM higher academic institution.
(3) *In recent years, a number of activities, which take place in the school environment, are offered to young people and are supportive (encouraging) for them to pursue higher education. Please mark the activities you take part in from the list below. You can choose more than one activity*. (see question No. 13 of Appendix A).

The proposed clubs of Physics, Chemistry, Mathematics, Robotics, Computer Science and Computer Engineering, and Biotechnology-Biochemistry (answers 1-2-3-4-5-6 of question No. 14 of Appendix A) were considered as activities that expose a young person to STEM fields. The other clubs were considered as non-STEM (answers 7-8-9-10-11-12-13 of question No. 13 of Appendix A). The order of preference of the above activities is to enhance the choice of students towards a particular academic direction and in a particular field of study. Based on the answers given to these questions, a three-tier variable was developed: (a) STEM activities, (b) non-STEM activities, and (c) no activities (answer 14 of question No. 14 of Appendix A).

(4) *Do you take any private lessons in the following subjects?* (see question No. 25 of Appendix A). The students are required to define how many hours they take private lessons in Math, Computers, and Natural Sciences on a weekly or monthly basis. The answers of each subject were then divided into three categories: 1—Yes, on a weekly basis, 2—Yes, but less than once a week, 3—No, I am not taking any private lessons in these subjects.

Self-efficacy: was measured by the following question: "If you were going to follow studies in higher education in a field that you were not be interested in, do you believe that these studies would be successful?"

Outcome expectations and student's social support:

Regardless of whether derived from their direct and indirect environment, they were measured by factor analysis of thirteen different statements in which the responders were asked to specify their level of agreement or disagreement on the basis of a four-level Likert-type scale 1—I disagree, 2—I probably disagree, 3—I probably agree, 4—I agree.

The purpose of the analysis was to categorize the statements which were related and to find the uncountable quantities which are indicated by each factor.

Comments: The question, "*Regarding your school performance, what is the area of study you would be most interested to study in higher education*" (see question No. 4 of Appendix A) with possible answers: 1—Humanitarian sciences (such as languages, literature, arts, etc.); 2—Social sciences (such as sociology, political studies, economics, psychology, etc.); 3—Business and administration sciences; 4—Law, 5—Medicine, 6—Medical Support professional education (such as Nursing); 7—Natural Sciences and Mathematics (such as Physical and Biological sciences, Mathematics, Statistics, Computer Science, etc.); 8—Agriculture; 9—Engineering Sciences; 10—Architecture; 11—Other", was modified as follows:

(i) Studies in higher education in non-STEM fields (answers 1-2-3-4-11)

(ii) Studies in higher education in STEM fields (answers 5-6-7-8-9-10).

Then, the second category (ii) was divided into two sub-categories: (a) Medicine (answers 5–6) and (b) higher education studies in other STEM fields (answers 7-8-9-10). As a result of this classification, the following three categories of students emerged: (1) Studies in higher education in non-STEM fields (answers 1-2-3-4-11), (2) higher education studies in Medicine (answers 5–6), and (3) Higher education studies in other STEM fields (answers 7-8-9-10).

It should be noted at this point that even though Medicine and Medical support professional education belong to STEM fields branches, in our research they are examined separately due to the fact that in these branches the social mission of the profession is accomplished and, thus, attract a large number of girls.

Statistical Analysis

The qualitative variables used in this study were expressed as absolute and relative frequency in each category of the variable. A Pearson chi-squared test (χ^2 test) was performed to assess possible differences that may exist in the questionnaire questions, in relation to the gender and students' family economic situation. Furthermore, factor analysis was applied, in order to investigate the existence of common factors in a specific set of questions. In this group of new variables, the Cronbach credibility factor α was applied (Cronbach's alpha). Finally, logarithmic regression was applied to explore the factors likely to be related to the student's decision to pursue or not studies in STEM fields. The statistical analysis was carried out in the statistical program IBM SPSS Statistics (version 21). All the statistical checks were performed at the statistical significance level of 5%.

4. Results

This part demonstrates the results obtained from the analysis of the questionnaires. Initially, the descriptive analysis of the participants' demographic characteristics was carried out and then followed the appropriate statistical analysis to investigate the research question. Table 2 exhibits the distribution (N, %) of participants' individual characteristics.

Table 2. Descriptive characteristics of students (N = 301).

	N (%)
Gender	
Boy	151 (50.17%)
Girl	150 (49.83%)
Education level	
8th grade	126 (41.86%)
9th grade	85 (28.24%)
10th grade	
Father's educational level	90 (29.90%)
Non-academic education	135 (44.85%)
Academic education	166 (55.15%)

Table 2. *Cont.*

	N (%)
Mother's educational level	
Non-academic education	140 (46.51%)
Academic education	161 (53.49%)
Do you have older siblings	
Yes	151 (50.17%)
No	150 (49.83%)
If yes, do they study at a higher education institution	
Yes	110 (72.85%)
No	41 (27.15%)
Students' perception of the family economic background	
Low	62 (21.38%)
Average	216 (74.48%)
High	12 (4.14%)
How important is it for you to continue tertiary education	
It is not important	11 (3.65%)
It is important	290 (96.35%)
Are you interested to study in an academic institution	
Non-STEM field	105 (34.88%)
STEM field	180 (59.80%)
No	16 (5.32%)
If you were going to follow studies in higher education in a field that you would not be interested in, do you believe that these studies would be successful?	
I wouldn't be able to succeed in my studies	178 (59.14%)
I would be able to succeed in my studies	123 (40.86%)
In case you decide to pursue higher education, will your family support you financially during your studies?	
Yes	231 (76.74%)
No	12 (3.99%)
I am not sure	58 (19.27%)
In case you decide to pursue higher education, will you be required to support financially your family during your studies?	
Yes	40 (13.29%)
No	123 (40.86%)
I am not sure	138 (45.85%)
Amongst your close circle of friends and family, who in your view are most likely to influence your decision to pursue or not to pursue higher education?	
My parents	193 (64.12%)
Relatives	19 (6.31%)
Teachers	20 (6.64%)
School counsellor	10 (3.33%)
Friends	32 (10.63%)
Other	27 (8.97%)
Do you know any people (in your close surroundings-family and friends) who hold an academic degree (do not count teachers and administration in your school)?	
Yes	281 (93.36%)
No	20 (6.64%)
Have you ever visited an academic institution?	
Yes, a STEM institution	141 (46.84%)
Yes, a non-STEM institution	38 (12.63%)
No	12 2(40.53%)
Extra-curricular activities	
Yes, STEM	109 (36.21%)
Yes, Non- STEM	68 (22.59%)
No	124 (41.20%)

Table 2. *Cont.*

	N (%)
Learning difficulties in Mathematics	
Not at all–Little	164 (54.49%)
Moderate–Very much	116 (38.54%)
I do not attend these lessons	21 (6.98%)
Learning difficulties in Computers	
Not at all–Little	137 (45.51%)
Moderate–Very much	80 (26.58%)
I do not attend these lessons	84 (27.91%)
Learning difficulties in Physics	
Not at all–Little	179 (59.47%)
Moderate–Very much	107 (35.55%)
I do not attend these lessons	15 (4.98%)
Learning difficulties in Biology	
Not at all–Little	198 (65.78%)
Moderate–Very much	78 (25.91%)
I do not attend these lessons	25 (8.31%)
Learning difficulties in Chemistry	
Not at all–Little	174 (57.81%)
Moderate–Very much	106 (35.22%)
I do not attend these lessons	21 (6.98%)
What is your average score in Mathematics	
Low	33 (11.79%)
Average	93 (33.21%)
High	154 (55.0%)
What is your average score in Computers	
Low	12 (5.53%)
Average	46 (21.20%)
High	159 (73.27%)
What is your average score in Physics	
Low	23 (8.04%)
Average	95 (33.22%)
High	168 (58.74%)
What is your average score in Biology	
Low	14 (5.07%)
Average	50 (18.11%)
High	212 (76.81%)
What is your average score in Chemistry	
Low	23 (8.21%)
Average	77 (27.5%)
High	180 (64.29%)
Do you take private lessons in Mathematics	
Yes, on a weekly basis	170 (56.48%)
Yes, but less often than once a week	13 (4.32%)
No	118 (39.20%)
Do you take private lessons in Computers	
Yes, on a weekly basis	20 (6.64%)
Yes, but less often than once a week	4 (1.33%)
No	277 (92.03%)
Do you take private lessons in the following subjects (Physics, Chemistry, Biology)	
Yes, on a weekly basis	167 (55.48%)
Yes, but less often than once a week	14 (4.65%)
No	120 (39.87%)

A factor analysis with Varimax rotation was then performed for question No. 6 of Appendix A: *"Please express the level of agreement or disagreement with the following statements"*, which includes 13 statements. The students were asked to answer a 4-level Likert scale with possible answers: 0 "I disagree", 1 "I probably disagree", 2 "I probably agree", 3 "I

agree". The purpose of factor analysis is to categorize the statements that are related and to find the unmeasured quantities indicated by each factor. Table 3 illustrates the results of the factor analysis.

Table 3. Factor analysis results for attitudes towards higher education.

	Factor Loadings	Cronbach's Alpha
Factor 1: Social value		0.62
School should encourage students to pursue higher education through courses or programs	0.70	
Everyone who is capable should pursue higher education	0.52	
I would be proud to be studying at a higher education Institution.	0.47	
It is important to acquire higher education	0.38	
It is important for me to have satisfactory school performance so that I can pursue higher education.	0.31	
Factor 2: Motivation movement		0.57
People with higher education credentials are more successful in life.	0.73	
People with higher education have distinctly higher social status in Greek society.	0.55	
People with a higher education degree are likely to practice higher-earned professions than those who do not have a higher education degree.	0.44	
Factor 3: Social support		0.52
Most of my teachers and school administrators encourage me to pursue higher education.	0.75	
My parents (or at least one of them) encourage me to pursue higher education.	0.44	

Based on the results of factor analysis, it appears that the data are suitable for applying factor analysis, as the statistical KMO gets a value of 0.755, which is considered satisfactory. In addition, according to Bartlett's sphericity test ($p < 0.001$), there are significant correlations between the items, in order to extract representative factors for all the statements. Table 3 indicates that three factors were obtained from this analysis. It also demonstrates the factor loadings of each statement with the factor to which it belongs, as well as Cronbach's alpha coefficient for each subset of statements, which were created according to the factor analysis. The first factor refers to the social value of higher education studies and the second on the motivation movement. These two factors reflect the outcome expectations. The third factor represents the perceived social support for academic education.

In addition, Cronbach's alpha coefficient for the first factor, which refers to the social value of higher education, is 0.62, suggesting a satisfactory reliability of this factor. For the second and third factors, Cronbach's alpha coefficient was 0.57 and 0.52 respectively, indicating less satisfactory reliability of these factors. It is worth noting that among the 13 statements of the 6th question in the above table, only ten are included. The remaining three did not show significant factor loadings and were therefore not included.

Considering the findings illustrated in Table 4, Chi-square test shows that there is a tendency for boys to be more interested in dealing with STEM fields. It is worth mentioning that 67.9% of boys choose a STEM field when the corresponding rate for girls is 55.2% ($p = 0.028$). Furthermore, it could be noted that there was an increased rate of interest of boys for STEM fields unrelated to Medicine (55.7% for boys, 29.7% for girls), along with a high percentage of girls versus boys dealing with Medicine and Medical Support education professions (25.5% for girls, 12.1% for boys) ($p < 0.001$). Finally, boys believe that they will succeed in their studies, even if they are not really interested in the field they choose to study ($p = 0$).

Table 4. Chi-square test for the evaluation of possible differences according to gender.

	Boy	Girl	*p*
Regarding your school performance and grades are you planning to pursue higher education			0.028
STEM fields	95 (67.9%)	80 (55.2%)	
Non-STEM fields	45 (32.1%)	65 (44.8%)	
Regarding your school performance what is the area of study are you most interested to study in higher education			<0.001
Medicine	17 (12.1%)	37 (25.5%)	
Rest STEM fields	78 (55.7%)	43 (29.7%)	
Non- STEM fields	45 (32.1%)	65 (44.8%)	
If you were going to follow studies in higher education in a field that you would not be interested in, do you believe that these studies would be successful?			0.023
I would not succeed in my studies	77 (51.0%)	101 (67.4%)	
I would succeed in my studies	74 (49.0%)	49 (32.7%)	

Additionally, Chi-square test shows that higher parental education has a positive impact on students' decision to continue studying in higher education, but without specifying the field (p = 0.001 for father's educational level, p = 0.011 for mother's educational level) (Table 5).

Table 5. Chi-square test for the evaluation of possible differences according to parental education.

	Regarding Your School Performance and Grades Are You Planning to Pursue Higher Education		
	Definitely Not	Definitely Yes	*p*
Father's educational level			0.011
Non-academic education	12 (75%)	123 (43.2%)	
Academic education	4 (25%)	162 (56.8%)	
Mother's educational level			0.011
Non-academic education	11 (68.9%)	129 (45.3%)	
Academic education	5 (31.3%)	156 (54.7%)	

Finally, a multi-factorial logarithmic regression model was applied (logistic regression), which contained all the above factors, aiming at developing a prediction model for students' response to higher education in STEM fields. The results are presented in Table 6.

Table 6. Logistic regression analysis for students' interest to study at STEM academic institutions.

Variables		OR *	*p*
Gender	Boy (cat. reference) Girl	 0.886	 0.831
Father's educational level	Non-academic degree (cat. reference) Academic degree (cat. reference)	 0.769	 0.703
Mother's educational level	Non-academic degree (cat. reference) Academic degree (cat. reference)	 0.698	 0.552
Student's perception of the family economic background	Low (cat. reference) Average High	 0.198 0.090	0.069 0.034 0.079
Self-efficacy	I am confident (for sure) I would not be able to succeed in my studies (cat. reference) I probably wouldn't be able to succeed in my studies I would probably be able to succeed in my studies I am confident (for sure) I would be able to succeed in my studies	 7.002 14.366 8.084	0.034 0.014 0.005 0.077

Table 6. *Cont.*

Variables		OR *	*p*
Extra-curricular activities	Yes, Non-STEM activities (cat. reference)		0.020
	Yes, STEM activities	8.166	0.010
	No	1.570	0.502
Have you ever visited an academic institution	Yes, a STEM institution (cat. reference)		0.086
	Yes, a non- STEM institution	0.091	0.029
	No	0.495	0.216
Do you take private lessons in Mathematics	Yes, on a weekly basis (cat. reference)		0.037
	Yes, but less often than once a week	0.521	0.710
	No	6.860	0.014
Do you take private lessons in Computers	Yes, on a weekly basis (cat. reference)		0.154
	Yes, but less often than once a week	44.559	0.179
	No	8.272	0.063
Do you take private lessons in the following subjects (Physics, Chemistry, Biology)	Yes, on a weekly basis (cat. reference)		0.002
	Yes, but less often than once a week	0.031	0.051
	No	0.071	0.002
Learning difficulties in Mathematics	Not at all–Little (cat. reference)		
	Moderate–Very much	0.203	0.038
Learning difficulties in Computers	Not at all–Little (cat. reference)		
	Moderate–Very much	2.598	0.178
Learning difficulties in Physics	Not at all–Little (cat. reference)		
	Moderate–Very much	0.544	0.403
Learning difficulties in Biology	Not at all–Little (cat. reference)		
	Moderate–Very much	0.509	0.311
Learning difficulties in Chemistry	Not at all–Little (cat. reference)		
	Moderate–Very much	0.397	0.226
What is your average score in Mathematics	Low (cat. reference)		0.379
	Average	0.503	0.541
	High	0.183	0.194
What is your average score in Computers	Low (cat. reference)		0.453
	Average	4.349	0.259
	High	2.105	0.549
What is your average score in Physics	Low (cat. reference)		0.128
	Average	2.754	0.458
	High	11.592	0.089
What is your average score in Biology	Low (cat. reference)		0.309
	Average	0.073	0.129
	High	0.078	0.147
What is your average score in Chemistry	Low (cat. reference)		0.053
	Average	12.202	0.112
	High	1.609	0.754
Social value		0.607	0.279
Motivational movement		2.695	0.018
Social support		1.480	0.338

* OR = Odds Ratio, $p < 0.05$.

According to this model, it appears that the factors that predict the dependent variable (STEM field selection in tertiary education) are the following five: the financial situation of the students' family, self-efficacy, the learning experiences, the difficulty in mathematics, and the motivational movement.

Specifically, children who consider their family to be in a middle economic situation, have a reduced probability of 80.2% of choosing STEM fields in tertiary education than those whose families are in a lower financial state (OR = 0.198, $p = 0.034$). It is clarified that the low and the low to medium economic situation has been considered as a low economic situation. Regarding the self-efficacy, students who responded that "I would probably not succeed in these studies" (OR = 7.002, $p = 0.014$) and "I would probably succeed in these studies"(OR = 14.366, $p = 0.005$) are more likely to choose STEM fields in tertiary education in relation to those who responded "I am sure I would not succeed in these studies".

Students' exposure to STEM activities includes visits to higher education STEM institutions, students' involvement in STEM programs and actions both in and outside classroom, private lessons in Maths and Computer and Natural Sciences. In particular, students who had participated in STEM activities have a greater chance of choosing STEM fields in tertiary education (OR = 8.166, $p = 0.010$). Furthermore, it was noticed that students who had visited a higher educational institution, which does not belong to a STEM field, were more likely to choose STEM fields in tertiary education in relation to those who have visited a STEM higher educational institution (OR = 0.091, $p = 0.029$).

Private courses were also correlated with the option of choosing STEM studies, with students who take private lessons in Natural Sciences (Physics, Chemistry, Biology) less often than once a week (OR = 0.031, $p = 0.051$), or who had not experienced private courses in Natural Sciences (OR = 0.071, $p = 0.002$) being less likely to follow STEM academic studies than those who had. Furthermore, students who had difficulty attending Maths (moderate to very much) had decreased chances of choosing STEM fields in higher education in contrast to those who had little or no difficulty (OR = 0.203, $p = 0.038$). Finally, students who believe that higher education gives them higher financial profits, social status, and a "successful" social life are more likely to choose STEM studies (OR = 2.695, $p = 0.018$).

5. Discussion-Conclusions

Based on the statistical analysis of the findings of this study, it appears that gender factor does not play a regulatory role in determining the expression of interest for STEM studies. Although literature data suggest that there is an under-representation of girls in dealing with these fields, this is not confirmed by this research.

Girls are under-represented in Polytechnic Schools and Schools of Sciences, where at Medical Schools the girls' attendance rate is higher than that of boys. The great interest of girls' preference for medicine eliminates the difference of under-representation in the remaining STEM fields and therefore gender is not a regulatory factor, as SCCT claims. However, this is not impressive if we take into consideration that girls have a high degree of self-efficacy for schools in which their social mission is carried out, and Medicine is a STEM field of social character and a strong element of offering to fellow human beings [40,41].

It is worth mentioning that in the Competition PISA of 2015, which takes place every three years under the auspices of OECD (Organization for Economic Cooperation and Development), with a main focus on Natural Sciences and Mathematics-based STEM courses, Greek students aged 15 years have exhibited the same performance in the above-mentioned subjects regardless of gender. Furthermore, it is noted that in Greece there are no significant differences in the performance of boys and girls in Physics and Mathematics. Certainly, the almost identical performance of boys and girls in the above subjects does not indicate their preference for the field of study they will deal with, but it is an indicator of their abilities and skills. The latter is based on the Socio-Cognitive Career Theory combined with environmental factors and learning experiences that contribute to the development of the cognitive mechanisms of the individual and from there on to the manifestation of interest. We should never omit that the person is dealing with those activities in which he/she has a high degree of self-efficacy.

Additionally, the low percentage of students who do not wish to continue their studies in higher education does not create a database for comparative study with those that will proceed with STEM and non-STEM studies.

Although gender factor does not play a regulatory role that determines the expression of interest for STEM studies, the significance is that our findings support that boys have a high level of self-efficacy perceptions both for traditional males' and females' work, while female students have only for female occupations [12,33].

In terms of students' perception of their economic family situation, it was revealed that students who are in low and low to average economic situations are more likely to be engaged in STEM studies. This result is in accordance with data that suggest that economically disadvantaged students are more likely to choose STEM fields for their studies [55], as well as from studies by George-Jackson and Lichtenberg, [56] and Lichtenberg and George-Jackson [57], which indicate that economically poor students have more confidence to deal with STEM fields. The survey by Chachashvili-Bolotin et al. [58] proves that the higher the student's economic family status is, the lower their interest in studying in STEM fields in tertiary education. In other words, economically disadvantaged chose STEM fields, keeping all other variables constant. This significant result is also confirmed by most recent research that suggests that economic disadvantages are related to STEM [55–58].

It has also been illustrated that students choosing STEM fields have a greater degree of self-efficacy than students who choose non-STEM fields. They are more confident about their abilities so they can successfully carry out a task, a finding that is in agreement with the relevant research findings, namely that people dealing with STEM fields are more confident about their capabilities for these fields [56,57].

The results of our research confirm literature studies [59–61,63], which relate the student's exposure to STEM actions and programs both within and outside the school with an interest in STEM studies in higher education. Students who have visited STEM academic institutions or participated in STEM groups are statistically more likely to choose STEM studies in higher education. Increased attendance of STEM courses and STEM training increases the chances of students' interest in STEM fields, reaffirming the principles of the Socio-Cognitive Career Theory [25,30,31].

Data of this study indicate that the student's exposure to extra classroom STEM activities contributes to interest enhancement towards future studies of cognitive subjects of the same spectrum. It seems that during their visit to such institutions, students are often taught lessons in science of increased difficulty, and through activities they adopt a scientific way of thinking [61]. Indeed, the sooner the person is exposed to such activities, the more likely they are to study in STEM fields [59,62–64], confirming the significance of our study.

Furthermore, this is in agreement with relative studies that indicate that students' performance and achievements in mathematics is one of the strongest predicting factors for further STEM studies [25] and it is confirmed for the first time in our research.

Finally, the mobility lever is a predictor variable for students interested in studying STEM in higher education. Research data indicate that children of low socioeconomic status choose occupations based on more external features, while students from higher social and economic status present a more internalized view of the choice of study and by extension, their profession. These external characteristics include remuneration, professional opportunities, basically the criteria of the mobilization lever [54]. It has already been mentioned that economically deprived choose studies based on the expected results to which the mobilization lever belongs [55]. The originality of this study is also based on this tendency.

Overall, in this research, learning experiences, student's exposure to STEM activities at the school environment and outside of it, self-efficacy, and outcome expectations were found to be positively related to the procedure of students' interest development to pursue STEM fields in higher education. On the contrary, the parental educational background only supports the student's decision to continue studies after high school, while students from low-income families are more likely to follow STEM studies. Finally, gender seems to be a non-regulatory factor. It is worth mentioning that in this research most of the examined factors supported the SCCT.

6. Limitations and Suggestions for Future Study

A "missing point" of the questionnaire used in this research could be an inclusion of a question concerning the professional activity of the students' parents. Perhaps we could have then drawn valuable conclusions about the fields of study in which students are interested, since there seems to be a correlation between father's profession and student's study field. This could be the subject of a study in a future survey.

Additionally, the research sample could be enlarged and not taken only from the city of Piraeus. In this case, we would also take into account the factor of the place of residence throughout the whole country. Another interesting feature in our survey could have been the participation of students studying at technical high schools, in which students receive a different educational level and practice. This could be an additional field for prospective research.

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Data Availability Statement: The data presented in this study are available on reasonable request from the corresponding author.

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Appendix A. The Questionnaire Distributed to the Students

Dear student, the answers you will give are clearly aimed at conducting research, the results of which will be at your disposal. The questionnaire maintains your anonymity and contributes to the research process. Therefore, we would like to thank you in advance for your participation.

It is clarified that in the following questionnaire as HIGHER EDUCATION is considered the attendance at a higher Academic Institution (University, College, higher technology institution), where you will receive a Bachelor or Master degree or Ph.D. Degree.

Guidance: In all of the following questions, circle the number that corresponds to your answer.

Students' Attitudes towards Higher Education

1. How important in your view is to pursue higher education?

Not important at all	1
Not so important	2
Fairly important	3
Very important	4
Extremely important	5

2. Regarding your school performance and grades, are you planning to pursue higher education?

Definitely not	1
Probably not	2
Probably yes	3
Definitely yes	4

Answer the following question if you have any doubts that you are planning to pursue higher education- that is, if you answered definitely not, or probably not to Question 2.

3. Why are you hesitating to pursue higher education? (You are welcome to mark more than one response)

I am not interested.	1
For economic (financial) reasons.	2
My grades and performance in High School do not allow me to pursue higher education.	3
I do not believe that I can succeed in higher education.	4
My family does not encourage me to pursue higher education.	5
It is a waste of time.	6
I am planning to engage my family business, which does not require higher education.	7
Other, what?	8

Answer the following question if you are planning to pursue higher education-that is, if you answered definitely yes or probably yes to question 2

4. Regarding your school performance what is the area of study you would be most interested to study in higher education? (You are welcome to choose only one response).

Humanities (such as languages, literature, arts, etc.)	1
Social sciences (such as sociology, political studies, economics, psychology, etc.)	2
Business and management sciences	3
Law	4
Medicine	5
Medical support profession education (such as nursing)	6
Natural Sciences and Mathematics (such as Physics, Chemistry, Biology, Mathematics, Statistics, Computer Science, etc.)	7
Agriculture	8
Engineering	9
Architecture	10
Other, what?	11

4a. Disregarding your school performance, what is the area of study you would be interested to study in higher education? (You are welcome to choose only one response).

Humanities (such as languages, literature, arts, etc.)	1
Social sciences (such as sociology, political studies, economics, psychology, etc.)	2
Business and management sciences	3
Law	4
Medicine	5
Medical support profession education (such as nursing)	6
Natural Sciences and Mathematics (such as Physics, Chemistry, Biology, Mathematics, Statistics, Computer Science, etc.)	7
Agriculture	8
Engineering	9
Architecture	10
Other, what?	11

5. If you were going to follow studies in higher education in a field that you would not be interested in, do you believe that these studies would be successful?

I am sure (confident) that I will not be able to succeed in my studies	1
I would probably not be able to succeed in my studies	2
I would probably be able to succeed in my studies	3
I am sure(confident) that I will succeed in my studies	4

6. Please express the level of agreement or disagreement with the following statements.

	Disagree	I probably Disagree	I probably Agree	Agree
Everyone who is capable should pursue higher education	1	2	3	4
It is important to acquire higher education	1	2	3	4
School should encourage students to pursue higher education through courses or programs.	1	2	3	4
It is important for me to have satisfactory school performance so that I can pursue higher education.	1	2	3	4
I would be proud to be studying at a higher education Institution.	1	2	3	4
People with higher education credentials are more successful in life.	1	2	3	4
People with higher education have distinctly higher social status in Greek society.	1	2	3	4
People with a higher education degree are likely to practice higher-earned professions than those who do not have a higher education degree	1	2	3	4
It is important to support young people at early stages of their lives with guidance regarding their pursuing higher education.	1	2	3	4
My parents (at least one) encourage me to pursue higher education.	1	2	3	4
Most of my teachers and school administrators encourage me to pursue higher education.	1	2	3	4
Most of my friends intend to pursue higher education.	1	2	3	4
My decision to pursue higher education depends on my ability to support it financially.	1	2	3	4

7. In case you decide to pursue higher education, will you get financial support from your parents?

Yes	1
No	2
I am not sure	3

8. If you decide to go to tertiary education, will you be required to support your family financially during your studies?

Yes	1
No	2
I am not sure	3

9. Amongst your close circle of family and friends, who in your view is most likely to influence your decision to pursue or not to pursue higher education? (You are welcome to choose only one response).

My parents	1
My relatives	2
My teachers	3
My school counselors	4
Friends	5
Other:	6

10. Do you know any people from your close surroundings-family and friends who hold an academic degree? (do not include your teachers or administration in your school).

Yes	1
No	2

Student's Knowledge about Higher Education

11. Have you ever visited an academic institution during your school visits?

Yes	1
No	2

Answer the following question if you answered yes to question 11

12. Which one/ones? (You are welcome to mark more than one answer)

National Technical University of Athens	1
Department of Positive Studies of University of Athens (such as Department of Physical sciences, Biological sciences)	2
Department of Computer sciences and Computer Engineering	3
Medical or Pharmacy School of Athens	4
Agricultural University of Athens	5
School of Philosophy of Athens	6
Panteion University of Athens	7
Theological School of Athens	8
University of Piraeus	9
Other, Which one?	10

13. Have you ever taken a School Vocational Guidance Test?

Yes	1
No	2

14. In recent years, a number of activities, which take place in the school environment, are offered to young people and are supportive (encouraging) for them to pursue higher education. Please mark the activities you take part in from the list below. You can choose more than one activity.

Physics Group	1
Chemistry Group	2
Maths Group	3
Group or Robotics Programs	4
Computer and Computer Engineering Group	5
Biotechnology and Biochemistry Group	6
Group of Philosophy and Social Studies	7
Diplomacy Group	8
Rhetoric and Antiology Group	9
Participation in the House of Adolescents Program	10
e-twinning	11
Environmental or Health Education Program	12
Other, What?	13
None	14

Answer the question below only if you have participated in any of the above activities

15. Taking into account the activities you noted that you have taken part in the previous question, which of these do you think had the greatest influence on your decision to follow studies in higher education, if you finally decided on this? Answer them in order of increasing interest.

1st	
2nd	
3rd	
4th	
5th	
6th	
7th	
8th	
9ht	
10th	
11th	
12th	
13th	
	I will not attend higher education

16. Was the participation in these activities useful for you? For example, did it contribute to your knowledge to enhance your interest in continuing your studies in higher education in similar sectors, expand your horizons on issues you did not know well about? Please explain.

17. What are some additional topics of activities you would have liked to hear about but were missing from the activities mentioned above?

Student's Personal Information

18. Gender

Boy	1
Girl	2

19. Which school do you attend?

20. What is your grade level?

8th grade	1
9th grade	2
10th grade	3

21. How many parallel classes do you have in your grade level in your school?

22. Which of the following lessons do you attend at school and belong to your guidance group? (you can mark more than one answer).

Modern Greek	1
Biology	2
History	3
Chemistry	4
Financially	5
Social science	6
Computer courses	7
Maths	8
Literature	9
Physics	10
Communication Sciences	11
Other, what?	12

23. How much would you say you have difficulty in attending these subjects in the school environment?

	None at All	A little	Moderate	Very Much	I Do not Attend These Lessons
a. Maths	1	2	3	4	5
b. Computers	1	2	3	4	5
c. Physics	1	2	3	4	5
d. Biology	1	2	3	4	5
e. Chemistry	1	2	3	4	5

24. What is your average score in these subjects?

	1. Below 59	2. Between 60–69	3. Between 70–79	4. Between 80–89	5. Between 90–100
a. Maths	1	2	3	4	5
b. Computers	1	2	3	4	5
c. Physics	1	2	3	4	5
d. Biology	1	2	3	4	5
e. Chemistry	1	2	3	4	5

25. Do you take any private lessons to the following subjects?

	Yes, on a Weekly Basis-note how Many Hours a Week	Yes, but less often than once a Week-Note how Many Hours a Month	No
a. Maths	1	2	3
b. Computers	1	2	3
c. Natural Sciences (Physics, Chemistry, Biology)	1	2	3

Information about Students' Background

26. What is your father's educational level?

Primary Education (having an elementary school certificate)	1
Secondary Education (junior high school or high school diploma or technical school diploma)	2
Post-secondary education	3
Academic Education (University, college degree, master, Ph.D. degree)	4

27. What is your mother's educational level?

Primary Education (having an elementary school certificate)	1
Secondary Education (junior high school or high school diploma or technical school diploma)	2
Post-secondary education	3
Academic Education (University, college degree, master or Ph.D. degree)	4

28. Do you have older siblings?

Yes	1
No	2

29. If yes, do any of them study at a higher academic institution?

Yes	1
No	2

30. In your opinion, how do you estimate the economic situation of your family?

Low	1
Low to Average	2
Average	3
Average to High	4
High	5
I do not know	6

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References

1. Lent, R.W.; Brown, S.D.; Hackett, G. Contextual supports & barriers to career choice: A social cognitive analysis. *J. Couns. Psychol.* **2000**, *47*, 36–49. [CrossRef]
2. Lent, R.W.; Brown, S.D.; Hackett, G. Toward a unifying social cognitive theory of career and academic interest, choice and performance (Monograph). *J. Vocat. Behav.* **1994**, *45*, 79–122. [CrossRef]
3. Lent, R.W.; Brown, S.D.; Hackett, G. Social Cognitive Career Theory. *Career Choice Dev.* **2002**, *4*, 255–311.
4. Bandura, A. *Psychological Modeling: Conflicting Theories*; Aldine Atherton: Chicago, IL, USA, 1971.
5. Bandura, A. Self Efficacy: Toward a unifying theory of behavioral change. *Psychol. Rev.* **1977**, *84*, 191–215. [CrossRef]
6. Bandura, A. *Social Learning Theory*; Prenctice-Hall: Egnlewood Cliffs, NJ, USA, 1977.
7. Bandura, A. Self-Efficacy Mechanism in Human Agency. *Am. Psychol.* **1982**, *37*, 122–147. [CrossRef]
8. Bandura, A. The self and mechanisms of agency. In *Psychological Perspectives on the Self*; Suls, J., Ed.; Erlbaum: Hillsdale, NJ, USA, 1982; pp. 3–39.
9. Bandura, A. *Self-Efficacy in Changing Societies*; Cambridge University Press: Cambridge, UK, 1995.
10. Bandura, A. *Self-Efficacy: The Exercise of Control*; W.H. Freeman and Company: New York, NY, USA, 1997.
11. Hackett, G. Self-efficacy in career choice and development. In *Self Efficacy in Changing Societies*; Bandura, A., Ed.; Cambridge University Press: Cambridge, UK, 1995.
12. Hackett, G.; Betz, N.E. A self-efficacy approach to the career development of women. *J. Vocat. Behav.* **1981**, *18*, 326–339. [CrossRef]
13. Bandura, A. Social Cognitive theory of personality. In *Handbook of Personality*, 2nd ed.; Pervin, L., John, O., Eds.; Guilford Press: New York, NY, USA, 1999; pp. 154–196.
14. Bandura, A. Exercise of human agency through collective efficacy. *Curr. Dir. Psychol. Sci.* **2000**, *9*, 75–78. [CrossRef]
15. Bandura, A. *Social Foundation of Thought & Action: A Cognitive Theory*; Prentice-Hall, Inc.: Englewood Cliffs, NJ, USA, 1986.
16. Barak, A. Vocational Interests. A cognitive view. *J. Vocat. Behav.* **1981**, *19*, 1–14. [CrossRef]
17. Eccles, J. Gender roles and women's achievement-related decision. *Psychol. Women Q.* **1987**, *11*, 135–172. [CrossRef]
18. Schunk, D.H. Self-efficacy and cognitive skill learning. In *Research on Motivation in Education, Vol.3: Goals and Cognitions*; Anes, C., Anes, R., Eds.; Academic Press: San Diego, CA, USA, 1989; p. 1344.
19. Vroom, V.H. *Work and Motivation*; Wiley: New York, NY, USA, 1964; p. 331.
20. Locke, E.A. Toward a theory of task motivation and incentives. *Organ. Behav. Hum. Perform.* **1968**, *3*, 157–189. [CrossRef]

21. Locke, E.A.; Latham, G.P. Work Motivation and Satisfaction: Light at the End of the Tunnel. *Psychol. Sci.* **1990**, *1*, 240–246. [CrossRef]
22. Astin, H.S. The meaning of work in women's lives: A sociopsychological model of career choice and work behavior. *Couns. Psychol.* **1984**, *12*, 117–126. [CrossRef]
23. Vondracek, F.W.; Lerner, R.M.; Schulenberg, J.E. *Career Development: A Life-Span Developmental Approach*; Erlbaum: Hillsdale, NJ, USA, 1986.
24. Ajzen, I. *Attitudes, Personality and Behaviour*; Open University Press: Stony Stratford, UK, 1988.
25. Wang, X. Why students choose STEM majors: Motivation, high school learning, and postsecondary context of support. *Am. Educ. Res. J.* **2013**, *50*, 1081–1121. [CrossRef]
26. Betz, N.E. Self-Efficacy Theory as a Basis for Career Assessment. *J. Career Assess.* **2000**, *8*, 205–222. [CrossRef]
27. Betz, N.E. Contributions of self-efficacy theory to career counseling. A personal perspective. *Career Dev. Q.* **2004**, *52*, 340–353. [CrossRef]
28. Betz, N.E. Career Self-Efficacy: Exemplary Research and Emerging Directions. *J. Career Assess.* **2007**, *15*, 403–422. [CrossRef]
29. Betz, N.E.; Hammond, M.; Multon, K. Reliability and validity of five-level response continua for the Career Decision Self-Efficacy Scale. *J. Career Assess.* **2005**, *13*, 131–149. [CrossRef]
30. Byars-Winston, A.; Estrada, Y.; Howard, C.; Davis, D.; Zalapa, J. Influence of social cognitive and ethnic variables on academic goals of underrepresented students in science and engineering: A multiple-groups analysis. *J. Couns. Psychol.* **2010**, *57*, 205–218. [CrossRef]
31. Lent, R.W.; Lopez, A.M.; Lopez, F.G.; Sheu, H.-B. Social cognitive career theory and the prediction of interests and choice goals in the computing disciplines. *J. Vocat. Behav.* **2008**, *73*, 52–62. [CrossRef]
32. Trusty, J. Effects of high school course-taking and other variables on choice of science and mathematics college majors. *J. Couns. Psychol.* **2002**, *80*, 464–474. [CrossRef]
33. Matsui, T.; Ikeda, H.; Ohnishi, R. Relations of sex-typed socialization to career self-efficacy expectations of college student. *J. Vocat. Behav.* **1989**, *35*, 1–16. [CrossRef]
34. Hannan, J.; Kahn, S. The relationship of socioeconomic status and gender to the occupational choices of grade 12 students. *J. Vocat. Behav.* **1989**, *34*, 161–178. [CrossRef]
35. Lapan, R.T.; Jingeleski, J. Circumscribing vocational aspirations in junior high school. *J. Couns. Psychol.* **1992**, *39*, 81–90. [CrossRef]
36. Lauver, P.J.; Jones, R.M. Factors associated with perceived career options in American, Indian White and Hispanic rural high school students. *J. Couns. Psychol.* **1991**, *38*, 159–166. [CrossRef]
37. O' Brien, K.M.; Friedman, S.M.; Tipton, L.C.; Linn, S.G. Attachment, separation, and women's vocational development: A longitudinal analysis. *J. Couns. Psychol.* **1997**, *47*, 301–315. [CrossRef]
38. O'Brien, V.; Martinez-Pons, M.; Kopala, M. Mathematics self-efficacy, ethnic identity, gender, and career interests related to mathematics and science. *J. Educ. Res.* **1999**, *92*, 231–235. [CrossRef]
39. Iskander, E.T.; Gore, P.A.; Furse, C.; Bergerson, A. Gender differences in expressed interests in engineering-related fields ACT 30-year data analysis identified trends and suggested avenues to reverse trends. *J. Career Assess.* **2013**, *21*, 599–613. [CrossRef]
40. Rollins, V.; Valdez, J.N. Perceived racism and career self-efficacy in African American adolescents. *J. Back Psychol.* **2006**, *32*, 176–198. [CrossRef]
41. Williams, C.M.; Subich, L. The gendered nature of career-related learning experiences: A social cognitive career theory perspective. *J. Vocat. Behav.* **2006**, *69*, 262–275. [CrossRef]
42. Hackett, G.; Betz, N.E.; Casas, J.M.; Rocha-Singh, I.A. Gender, ethnicity, and social cognitive factors predicting the academic achievement of students in engineering. *J. Couns. Psychol.* **1982**, *39*, 527–538. [CrossRef]
43. Modi, K.; Schoenberg, J.; Salmond, K. *Generation STEM: What Girls Say about Science, Technology, Engineering, and Math. A Report from the Girl Scout Research Institute*; Girl Scouts of the USA: New York, NY, USA, 2012.
44. Falkowski, K.; Falk, W. Homemaking as an occupational plan: Evidence from a national, longitudinal study. *J. Vocat. Behav.* **1983**, *22*, 227–242. [CrossRef]
45. Watson, M.; Stead, G. A longitudinal study of career decidedness among White South African high school students. *J. Vocat. Behav.* **1994**, *45*, 261–269. [CrossRef]
46. Dillard, J.; Perrin, D. Puerto Rican, Black and Anglo adolescents career aspirations, expectations and maturity. *Career Dev. Q.* **1980**, *28*, 313–321. [CrossRef]
47. Farmer, H.S. Model of career development and achievement motivation for women and men. *J. Couns. Psychol.* **1985**, *3*, 363–390. [CrossRef]
48. Human, H. The relationship of social status and vocational interests. *J. Couns. Psychol.* **1956**, *3*, 12–16. [CrossRef]
49. Vigod, Z. The relationship between occupational choice and parental occupation. *Alta. J. Educ. Res.* **1972**, *18*, 287–294.
50. Moser, W.B. The influence of certain cultural factors upon the selection of vocational preferences. *J. Educ. Res.* **1952**, *45*, 523–526. [CrossRef]
51. McWhirter, E.H. Perceived barriers to education and career: Ethnic and gender differences. *J. Vocat. Behav.* **1997**, *50*, 124–140. [CrossRef]
52. Richie, B.S.; Fassinger, R.E.; Prosser, J.; Robinson, S. Persistence, connection, and passion: A qualitative study of the career development of highly achieving African American-Black and White women. *J. Couns. Psychol.* **1997**, *44*, 133–148. [CrossRef]

53. Legewie, J.; DiPrete, T.A. The high school environment and the gender gap in science and engineering. *Sociol. Educ.* **2014**, *87*, 259–280. [CrossRef]
54. Chaves, A.P.; Diemer, M.A.; Blustein, D.A.; Gallagher, L.A.; DeVoy, J.E.; Casares, M.T.; Perry, J.C. Conceptions of work: The view for urban youth. *J. Couns. Psychol.* **2004**, *51*, 275–286. [CrossRef]
55. Beattie, I.R. Are all "adolescent econometricians" created equal? Racial, class, and gender differences in college enrollment. *Sociol. Educ.* **2002**, *75*, 19–43. [CrossRef]
56. George-Jackson, C.E.; Lichtenberger, E.J. *College Confidence: How Sure High School Students Are of Their Future Majors*; Illinois Education Research Council: Edwardsville, IL, USA, 2012.
57. Lichtenberger, E.; George-Jackson, C.E. Predicting high school students' interest in majoring in a STEM field: Insight into high school students' postsecondary plans. *Sociol. Educ.* **2013**, *28*, 19–38. [CrossRef]
58. Chachashvili-Bolotin, S.; Milner-Bolotin, M.; Lissitsa, S. Examination of factors predicting secondary students' interest in tertiary STEM education. *Int. J. Sci. Educ.* **2016**, *38*, 366–390. [CrossRef]
59. Sahin, A.; Ayar, M.C.; Adiguzel, T. STEM related after-school program activities and associated outcomes on student learning. *Educ. Sci. Theory Pract.* **2014**, *14*, 309–322. [CrossRef]
60. Tsui, L. Effective strategies to increase diversity in STEM fields: A review of the research literature. *J. Negro Educ.* **2007**, *76*, 555–581. [CrossRef]
61. McGee-Brown, M.; Martin, C.; Monsaas, J.; Stombler, M. *What Scientists Do: Science Olympiad Enhancing Science Inquiry through Student Collaboration, Problem Solving, and Creativity*; National Science Teachers Association Meeting: Philadelphia, PA, USA, 2003.
62. Maltese, A.V.; Tai, R.H. Eyeballs in the fridge: Sources of early interest in science. *Int. J. Sci. Educ.* **2010**, *32*, 669–685. [CrossRef]
63. Tindall, T.; Hamil, B. Gender disparity in science education: The causes, consequences, and solutions. *Education* **2004**, *125*, 282–296.
64. Betz, N.E.; Borgen, F.H.; Harmon, L.W. Vocational confidence and personality in the prediction of occupational group membership. *J. Career Assess.* **2006**, *14*, 36–55. [CrossRef]
65. Lent, R.W.; Brown, S.D.; Hackett, G. Career Development from a social cognitive perspective. *Career Choice Dev.* **1996**, *3*, 373–421.
66. Su, R.; Rounds, J.; Armstrong, P.I. Men and things, women and people: A meta-analysis of sex differences in interests. *Psychol. Bull.* **2009**, *135*, 859–884. [CrossRef] [PubMed]
67. Fouad, N.A.; Smith, P.L. A test of social cognitive model for middle school students: Math and science. *J. Couns. Psychol.* **1996**, *43*, 338–346. [CrossRef]
68. Lent, R.W.; Brown, S.D.; Larkin, K.C. Self-efficacy in the prediction of academic performance and perceived career options. *J. Couns. Psychol.* **1986**, *33*, 265–269. [CrossRef]