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Influence of expectancies of success on the choice of vocational education or scientific-technological baccalaureate

Influencia de las expectativas de éxito en la elección de Formación Profesional o Bachillerato científico-tecnológico

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ABSTRACT

The number of students pursuing scientific-technological careers is declining, with significant gender differences. Similarly, at the end of the compulsory stage, an increasing number of students continue their studies in vocational education rather than the baccalaureate. The reasons for this trend are not clearly known, but it seems that students' expectancies and the influence of their teachers and parents may play a role. Thus, this study examines the impact of students' expectancies of success in science and technology, as well as their perceptions of their parents and teachers' expectancies of success, on their choice of study

type (vocational education or baccalaureate) and branch (scientific-technological or not). A convenience sample of 276 students was surveyed using a valid and reliable instrument in a quantitative, explanatory design. The findings show that students and their parents' expectancies of success have a strong influence on the choice of baccalaureate studies in boys, but not in girls. In addition, the choice of scientific-technological studies is influenced by their expectancies of success and those of their parents in boys, and by their expectancies of success and those of their teachers in girls. These findings emphasize the importance of the construct of expectancies of success in the formation of scientific vocations and the academic orientation. For this reason, to increase scientific-technical vocations, it is necessary to implement methodologies and strategies that improve students' expectancies of success in science and technology, as well as the expectancies that their parents and teachers place on them.

Keywords: expectancies of success, vocational education, baccalaureate, science, technology

RESUMEN

Existe un descenso significativo en el número de estudiantes matriculados en carreras científico-tecnológicas, con notables diferencias de género. Asimismo, cada vez son más los y las estudiantes que continúan sus estudios en la Formación Profesional en lugar del Bachillerato al final de la etapa obligatoria. No se conocen claramente los motivos de esta tendencia, pero parece que las expectativas de los estudiantes y la influencia de su profesorado y madres y padres podrían tener un papel relevante. Por este motivo, esta investigación analiza el impacto de las expectativas de éxito en ciencias y tecnología en la elección del tipo de estudios (Bachillerato o Formación Profesional), así como en la rama elegida (científico-tecnológica o no). Para ampliar el ámbito del estudio, también se considera la percepción que posee el estudiantado sobre las expectativas de éxito que sus padres, madres, y profesorado tienen sobre ellos. El diseño fue cuantitativo, de tipo explicativo, utilizando un instrumento válido y fiable para encuestar a una muestra de conveniencia de 276 estudiantes. Los resultados revelan que las expectativas de éxito del estudiantado y la de sus padres y madres tienen un alto impacto en la elección de estudios de Bachillerato en los chicos, pero no en las chicas. Por otro lado, los hallazgos revelan que la elección de estudios científico-tecnológicos está influida por las propias expectativas de éxito y la de sus padres/madres, en el caso de los chicos, y por las propias expectativas de éxito y las de su profesorado, en el caso de las chicas. Estos resultados ponen de manifiesto la importancia del constructo expectativas de éxito en la orientación académica, así como en la formación de las vocaciones científicas. Por este motivo, para el fomento de las vocaciones científico-técnicas sería necesario poner en práctica metodologías y estrategias de enseñanza que mejoren las expectativas de éxito de los estudiantes, así como desarrollar intervenciones que mejoren las expectativas que sus padres/madres y profesorado les depositan.

Palabras clave: expectativas de éxito, formación profesional, bachillerato, ciencias, tecnología

INTRODUCTION

Spain has been experiencing a decline in the number of students interested in scientific and technological careers. The latest report from the Ministry of Universities on data and figures from the Spanish University System (2022) records an 8.1% decrease in the number of students enrolled in Sciences and a 26.2% decrease in the case of Engineering and Architecture compared to 15 years ago. Additionally, there are significant gender gaps. For example, this report indicates that in the 2020/2021 academic year, there was a high percentage of women in Health Sciences (71.4%), while their presence was low in Engineering and Architecture (25.7%). On the other hand, the field with the most gender parity was Sciences, with 50.7% of enrollees being women. However, there are inequalities in terms of gender representation in some disciplines; for example, women make up only 26.65% of students in physics-related disciplines (Grañeras-Pastrana et al., 2022).

This issue is also observed at the non-university levels of the education system, where there is a decrease in the number of students interested in baccalaureate studies and an increase in students interested in vocational education. Despite a balanced distribution in the number of students in the Science and Technology track of Baccalaureate (47.47% female students), girls represent less than 20% of students in vocational education programs related to fields such as Construction and Civil Works, Electricity and Electronics, or Information Technology and Communications. However, they constitute a majority in vocational education programs related to Chemistry and Healthcare (Grañeras-Pastrana et al., 2022).

Research in science education has focused on the affective and attitudinal domain of students as a potential explanation for the decline in scientific vocations (Potvin and Hasni, 2014; Toma and Lederman, 2022; Tytler, 2014). Among the numerous variables investigated, expectancies of success have received significant attention (Toma, 2021; Wigfield and Eccles, 2020). This construct was proposed by Eccles and Wigfield (1995) in their expectancy-value theory, one of the frameworks for studying students' choices, persistence, and performance. They defined expectancies of success as students' beliefs about how well they will perform in a future task (Eccles and Wigfield, 1995, 2020), closely related to the concept of self-efficacy proposed by Bandura et al. (2001). There is a relationship between these concepts and the choice of educational pathways, as well as a positive impact on academic performance and motivation toward schoolwork (Martínez-Vicente et al., 2023). Thus, nearly four decades of educational research using this theoretical framework reveals that expectancies of success play a significant role in the selection of scientific and technological university careers (Wigfield and Eccles, 2020).

However, the decline in scientific and technological vocations begins to be observed as early as secondary education (Maltese and Tai, 2011). Nevertheless,

both companies and society as a whole are increasingly demanding highly qualified professions related to science and technology (Ra et al., 2019). Therefore, given the current situation where it is necessary to increase students' interest in scientific and technological university careers, it is important to understand which variables influence students in their choice between vocational education and baccalaureate (the Spanish pre-university program), which serves as the first gateway to science-related university careers. To the best of the authors' knowledge, the literature has overlooked the impact of expectancies of success on the choice between vocational education and baccalaureate studies. Hence, this research embarks on this endeavor. Specifically, the following research questions were addressed:

(i) What influence do students' expectancies of success in science and technology, as well as those of their parents and teachers, have on their choice between vocational education and baccalaureate type of studies?

(ii) What influence do students' expectancies of success in science and technology, as well as those of their parents and teachers, have on their choice of science and technology-related studies?

METODOLOGY

Design and context

This is a quantitative, explanatory study that encompasses research aimed at testing models of relationships between a set of variables derived from an underlying theory (Ato et al., 2013). Data collection took place during the months of May and June 2022. After obtaining the necessary permissions from the institutions and teachers contacted through convenience sampling, they were provided with the questionnaire to share with the students, ensuring voluntary, anonymous, and confidential participation.

Participants

Through convenience sampling (Cohen et al., 2018), a total of 276 students participated in the study. They were either enrolled in vocational education (n = 87, 65.5% in science and technology programs) or baccalaureate (n = 189, 64.6% in science and technology track) in the cities of Burgos (86.2%), Madrid (11.6%), or Salamanca (2.2%). The mean age of the participants was 18.05 years (SD = 4.56; MD = 17). Slightly more than half of the sample identified as female (51.3%), while the rest identified as male.

Instruments

The instrument used for measuring expectancies of success was designed and validated by Thomas and Strunk (2017) and was available in three versions suitable for students, parents, and teachers. The student version consisted of seven items (e.g., I can get good grades in science and technology; Science and technology are challenging for me). In the parent version, the same items were used, but the wording was modified to reflect the student's beliefs about their parents' expectancies of success. For example, the item "I can get good grades in science and technology" was modified to "During secondary school, I perceived that my parents believed I could get good grades in science and technology." Finally, the teacher version included similar wording changes (e.g., During secondary school, I perceived that my teachers believed I could get good grades in science and technology).

Validity and reliability of the instruments

Firstly, the construct validity and internal reliability of each version of the instrument were examined, as the original version was published in English. The items were adapted to Spanish following a cross-cultural translation procedure (Beaton et al., 2000). Subsequently, an exploratory factor analysis was conducted to determine to what extent the Spanish versions of the instrument have the same factorial structure as the original versions. Specifically, the items were subjected to a robust exploratory factor analysis using the Maximum Likelihood method, as this procedure provides more accurate results and is theoretically superior to other extraction methods (Ferrando et al., 2022). The number of factors to extract was determined using parallel analysis (Lloret-Segura et al., 2014). Consistent with the original instruments and Eccles and Wigfield's Expectancy-Value Theory (1995, 2020), a one-dimensional structure is expected for each version of the instrument (students, parents, teachers). The reliability of internal consistency was established using Cronbach's alpha (α) and McDonald's omega (ω), with appropriate minimum values above .70.

The Kaiser-Meyer-Olkin (KMO) index and Bartlett's test of sphericity indicated that the data were suitable for exploratory factor analysis. Specifically, the KMO values were .86, .88, and .87, respectively for the student, parent, and teacher versions, and Bartlett's test of sphericity was statistically significant ($p < .001$) in all three cases. The exploratory factor analysis revealed the presence of a two-dimensional structure in all three questionnaires, which was supported by the results of the parallel analysis (see the scree plots and parallel analysis charts in the Appendix).

However, it is important to note that the second factor is composed of items that are phrased negatively; this would seem to indicate that it is a statistical artifact rather than an appropriate factorial structure (see Tables 1-3). Thus, even though two out of the three versions of the instrument (students and teachers) reveal two factors with eigenvalues greater than 1, this criterion is not recommended in the literature as it may result in an excessive extraction of factors (Lloret-Segura et al., 2014). Furthermore, specialized literature indicates that negatively phrased items often load onto another factor, as is the case here (Zhang et al., 2016). Therefore, in instruments where the structure is unidimensional, the use of negative items can distort the dimensionality of the scale. Consequently, given these limitations of negative items, and because the two-dimensional structure is not in line with the theoretical foundation of the construct of expectancies of success (Eccles and Wigfield, 1995, 2020), the decision has been made to retain unidimensional structures, which exhibit appropriate factor loadings and optimal internal consistency reliability.

Therefore, the questionnaire for students explained 47.9% of the variance, and in the present sample, the scores exhibited good reliability (α = .85, ωt = .83). Regarding the questionnaire assessing parental expectancies of success, the one-dimensional structure explained a total of 46.7% of the variance and also yielded scores with adequate reliability in the current sample (α = .87, ωt = .84). Finally, the one-dimensional version of the instrument measuring teacher expectancies of success explained a total of 44.4% of the variance and also demonstrated good score reliability in the current sample (α = .87, ωt = .87). These values suggest that the instrument in its adapted Spanish version has evidence of validity and reliability that meets current psychometric standards (Ferrando et al., 2022; Lloret-Segura et al., 2014).

Table 1

Exploratory Factor Analysis for the Student Version

	Factor		Factor[1]
	I	II	I
1. I am confident that I can learn science and technology.	.767		.763
2. I don't believe I can pursue science and technology in higher education (e.g., university) (r)		.764	.330
3. Science and technology are complicated for me (r)		.768	.477
4. I can get good grades in science and technology	.876		.860

	Factor		Factor[1]
	I	II	I
5. I am not one of those who excel in science and technology (r).		.808	.483
6. I believe I could learn the most complex scientific and technological content.	.841		.828
7. I can excel in science and technology.	.864		.882

Note.[1]unidimensional structure; (r) reverse-scored items.

Table 2

Exploratory Factor Analysis for the Parents version

	Factor		Factor[1]
	I	II	I
1. ...were confident that I could learn science and technology.	.779		.780
2. ... believed I wouldn't be able to pursue science and technology in higher education (e.g., university) (r)		.871	.338
3. ... believed science and technology was complicated for me (r)		.859	.366
4. ... believed I could achieve good grades in science and technology	.824		.838
5. ... believed I am not one of those who excel in science and technology (r)		.828	.315
6. ... believed I could learn the most complex scientific and technological content	.792		.789
7. ... believed I could be good at science and technology	.944		.936
8. ... believed I could excel in science and technology	.953		.949
9. ... believed I wasn't good at science and technology (r)		.767	.382

Note.[1]unidimensional structure; (r) reverse-scored items; the items were preceded by the prompt: "During high school, I noticed that my parents…".

Table 3
Exploratory Factor Analysis for the Teacher version

	Factor		Factor[1]
	I	II	I
1. ...were confident that I could learn science and technology.		.733	.360
2. ... believed I wouldn't be able to pursue science and technology in higher education (e.g., university) (r)	.801		.815
3. ... believed science and technology was complicated for me (r)	.916		.908
4. ... believed I could achieve good grades in science and technology		.799	.398
5. ... believed I am not one of those who excel in science and technology r)	.894		.886
6. ...believed that I could be good in science and technology		.877	.406
7. ...believed that I could Excel in science and technology		.878	.319
8. ...believed that I was bad at Science and Technology (r)	.861		.853

Note.[1]unidimensional structure; (r) reverse-scored items; the items were preceded by the prompt: "During high school, I noticed that my teachers…".

Data analysis

Various independent samples t-tests were conducted to examine potential differences in levels of expectancies based on the type of studies (baccalaureate or vocational education) and field (scientific-technological or non-scientific-technological). The statistical assumptions were met (Knapp, 2018): (i) normal distribution of variables (kurtosis and skewness ±2); and (ii) no violation of the assumption of variance homogeneity (p values > .05). Cohen's d was used to determine the effect size: small (.2), moderate (.5), and large (.8).

Additionally, a logistic regression model was employed with three continuous variables (student expectancies, parental expectancies, and teacher expectancies) after meeting the required statistical assumptions (Knapp, 2018): (i) inspection of histograms and kurtosis and skewness levels (±2) indicated a normal distribution of variables; and (ii) Pearson correlation between variables ranged from .62 to .70, confirming the absence of multicollinearity issues in the data. Given the sufficient sample size, both analyses were conducted independently for girls and boys.

RESULTS

RQ1. What influence do students' expectancies of success in science and technology, as well as those of their parents and teachers, have on their choice between vocational education and baccalaureate type of studies?

The independent samples *t*-tests (Figure 1) revealed that, in the case of boys, vocational education students have significantly higher expectancies of success than their baccalaureate counterparts t (133) = 2.04, p = .04, d = .35, with a medium effect size. Conversely, for girls, statistically significant differences were found, with a medium effect size, in favor of those enrolled in baccalaureate in the expectancies of success of their parents t (139) = -2.51, p = .01, d = .48, and those of their teachers (139) = -2.45, p = .02, d = .49.

Figure 1

Expectancies of success in vocational education and baccalaureate

Note. * p < .05.

Regarding the logistic regression analysis (Table 4), the model with the three predictor variables was statistically significant for boys χ^2 (3, n = 135) = 14.72,

$p < .01$, but not for girls χ^2 (3, n = 141) = 7.94, p = .05). This indicates that, in the case of girls, their expectancies of success, those of their parents, and those of their teachers do not influence or predict their choice of studies. Conversely, in the case of boys, the model explained 14% (Nagelkerke R^2) of the variance in their choice of study type.

The strongest predictor was the expectancies of success from their parents, with an odds ratio of 2.61 (p = .002). This suggests that boy students whose parents have high expectancies of success in science and technology for them are more than twice as likely to enroll in baccalaureate studies compared to students whose parents have low expectancies of success.

The second statistically significant predictor was their own expectancies of success, with an odds ratio of 0.36 (p = .001). This indicates that, surprisingly, students with high expectancies of success in science and technology are less likely to enroll in baccalaureate studies than their peers with low expectancies of success. Finally, the expectancies of the teachers did not reach statistical significance (p = .498).

Table 4

Predictive model for baccalaureate choice

	B	SE	Wald	Odds ratio	95% CI EXP(B)	
					Lower	Upper
Boys						
Expectancies students	-1.02	.33	9.60	.36*	.19	.69
Expectancies parentes	.96	.34	7.92	2.61*	1.34	5.10
Expectancies teachers	-.20	.30	.46	.82	.46	1.47
Constant	1.44	.99	2.09	4.21		
Girls						
Expectancies students	-.33	.35	.92	.72	.36	1.42
Expectancies parentes	.42	.34	1.53	1.52	.78	2.93
Expectancies teachers	.46	.37	1.54	1.59	.77	3.28
Constant	-.63	.86	.54	.53		

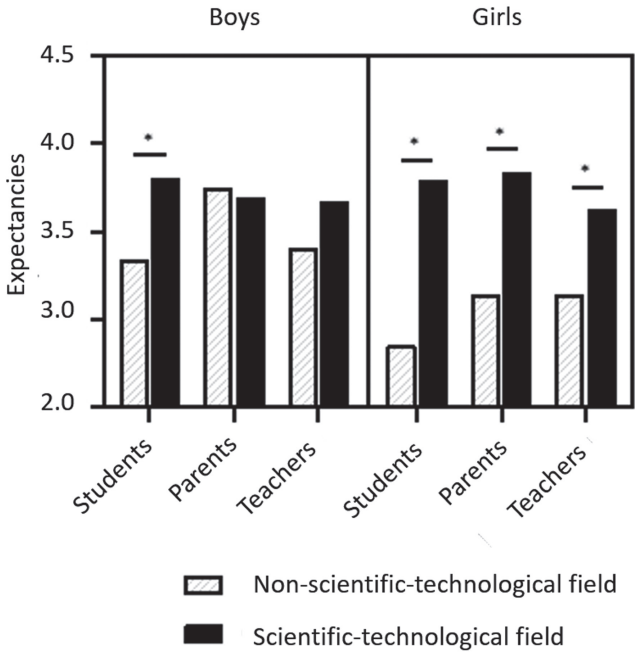
Note. * $p < .05$; SE (standard error); CI (confidence interval).

RQ2. What influence do students' expectancies of success in science and technology, as well as those of their parents and teachers, have on their choice of science and technology-related studies?

The independent samples *t*-tests (Figure 2) revealed that, in the case of boys, students in scientific and technological fields have significantly higher expectancies of success in science and technology than their peers in other fields of study, with a moderate effect size, t (133) = 2.51, p = .01, d = .57. For girls, statistically significant differences were found with moderate to large effect sizes in favor of those enrolled in scientific and technological studies in all three variables: their own expectancies of success t (139) = 7.22, p < .01, d = 1.23, those of their parents t (139) = 4.67, p < .01, d = 79, and those of their teachers t (139) = 3.28, p < .01, d = .56.

Figure 2

Expectancies of success in scientific-technological and other type of studies



Note. * p < .05.

Regarding the logistic regression analysis, the model was statistically significant for both boys χ^2 (3, n = 135) = 12.85, p < .01, and girls χ^2 (3, n = 141) = 52.54, p < .01, explaining 15.4% and 41.5% (Nagelkerke R2) of the variance in the chosen

study mode (scientific and technological or not), respectively. Table 5 summarizes the results of the logistic analysis.

For boys, the variable with the highest statistical significance was their expectancies of success, with an odds ratio of 3.13 (p = .005), suggesting that students with high expectancies of success in science and technology are three times more likely to enroll in scientific and technological studies. The second significant variable was parental expectancies, with an odds ratio of 0.32, indicating that students whose parents express high expectancies of success are more likely to enroll in non-scientific and technological studies. Finally, teacher expectancies did not make a significant contribution to the model (p = .165).

On the other hand, for girls, the variable with the highest statistical significance was also their own expectancies of success, with an odds ratio of 9.22 ($p < .001$). These values indicate that girls with high levels of expectancies of success in science and technology are nine times more likely to choose scientific and technological studies. Additionally, teacher expectancies also influence their choice of studies, but in an inverse manner, as indicated by the odds ratio of 0.32 (p = .011). Therefore, female students whose teachers have high levels of expectancies of success are less likely to enroll in scientific and technological studies. Finally, parental expectancies do not influence their decisions ($p = .154$).

Table 5

Predictive model for scientific-technological type of studies

	B	SE	Wald	Odds ratio	95% CI EXP(B)	
					Lower	Upper
Boys						
Expectancies students	1.14	.41	7.87	3.13*	1.41	6.96
Expectancies parentes	-1.14	.49	5.41	.32*	.12	.84
Expectancies teachers	.62	.45	1.92	1.86	.77	4.48
Constant	-.43	1.31	.11	.65		
Girls						
Expectancies students	2.22	.51	19.22	9.22*	3.42	24.90
Expectancies parentes	.58	.41	2.04	1.79	.80	4.00
Expectancies teachers	-1.13	.45	6.42	.32*	.13	.77
Constant	-5.82	1.18	24.46	.00		

Note. * $p < .05$; SE (standard error); CI (confidence interval).

DISCUSSION

The present study analyzed the impact of students' expectancies of success in science and technology on their choice of baccalaureate or vocational education studies, as well as the branch (scientific and technological or not). To broaden the scope of the study, the perception that students have of their parents' and teachers' expectancies of success for them was also considered. In general, the results indicate that expectancies of success are a significant factor in students' selection. Specifically, the expectancies of success of boys and their parents played a prominent role in the choice of baccalaureate or vocational education studies, while these factors had no effect on girls. On the other hand, the expectancies of success for both boys and girls were significant when it came to pursuing baccalaureate or vocational education studies related to science or technology. Similarly, the expectancies of success of parents, in the case of boys, and teachers, for girls, influenced the selection of a scientific and technological field. These findings are consistent with previous research demonstrating the impact of expectancies of success on study selection in secondary school students (Aschbacher et al., 2010, 2014; Bøe, 2012; Guo, Marsh, et al., 2015; Guo, Parker, et al., 2015), vocational education (Merino Pareja et al., 2020), and university (Phan, 2014). The results presented align with other studies that analyze the influence of self-perceived abilities on the choice of vocational education programs, showing gender differences, with boys opting for scientific and technological options while girls prefer studies related to human interaction (Santana Vega et al., 2019; Sánchez-Martín, et al., 2023). However, these findings are novel in that they assess the influences of students' expectancies of success, their parents, and their teachers on the choice between vocational education and baccalaureate studies, as well as between vocational education and baccalaureate studies related or unrelated to the scientific and technological field. Consequently, the study's results are relevant and have important educational implications.

Educational implications

Regarding the choice between vocational education and baccalaureate studies, the implications differ for boys and girls. Surprisingly, in the case of boys, those with higher expectancies of success chose vocational education over baccalaureate, and there were no differences in parental and teacher expectancies of success between the two groups. However, in the case of girls, those with higher expectancies of success from their parents and teachers chose baccalaureate studies. Therefore, these results suggest that educational measures aimed at encouraging girls to pursue baccalaureate studies should focus on the development, implementation,

and practice of tools and methodologies that improve the perception of teacher and parental expectancies of success in girls.

Regarding the choice of scientific and technological studies, boys with higher expectancies of success in science and technology chose an educational option related to this field. Additionally, the results show that girls pursuing studies related to science or technology outperform their peers in terms of high levels of their own expectancies of success, those of their parents, and those of their teachers. Therefore, educational initiatives aimed at increasing interest in scientific and technological studies should provide experiences that enhance students' expectancies of success, such as the use of inquiry-based teaching methods (Muñoz-Domínguez et al., 2022). Furthermore, in the case of girls, these educational measures should include specific strategies to effectively convey parental and teacher expectancies of success to students.

Limitations and avenues for future studies

Despite their importance and interest, it is important to consider the following limitations when interpreting these results. Firstly, since the sample for this study was collected using convenience sampling techniques, the results cannot be generalized to all Spanish students. This underscores the need for further research with a representative sample. Secondly, the expectancies of success from parents and teachers were collected based on the beliefs and perceptions of the students. It would be interesting to replicate this study by also surveying parents and teachers and analyzing whether their self-reported expectancies of success, compared to the students' beliefs, provide any additional explanatory value.

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APPENDIX

Figure 3

Sedimentation graph with results of parallel analysis for the questionnaire "students' expectancies of success"

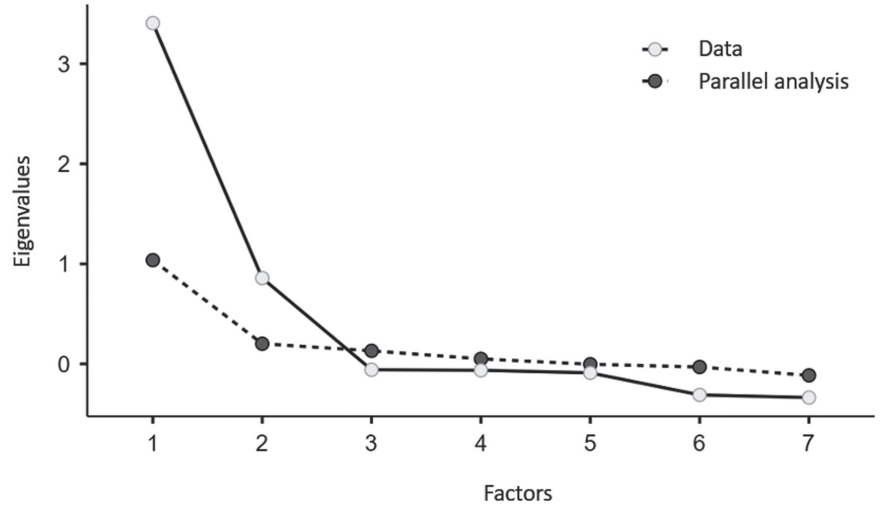

Figure 4

Sedimentation graph with results of parallel analysis for the questionnaire "parents' expectancies of success".

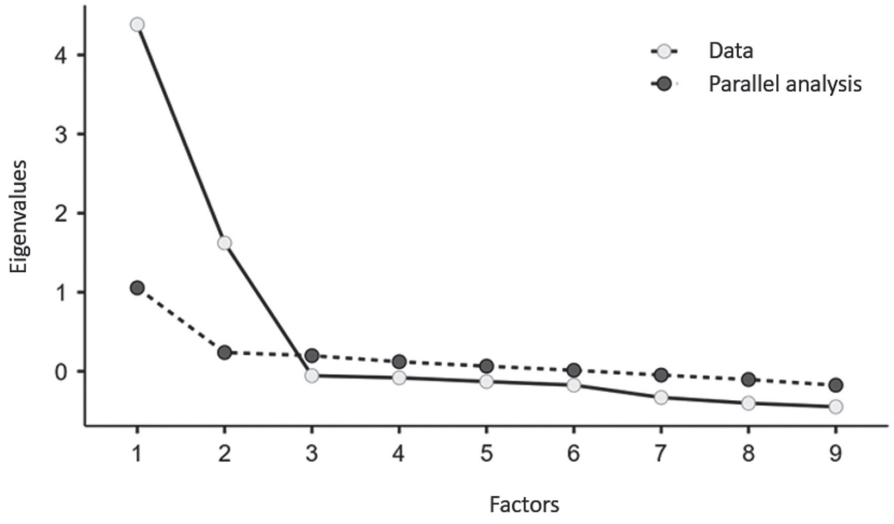

Figure 5

Sedimentation graph with results of parallel analysis for the questionnaire "teachers' expectancies of success".