SOTIROSKA IVANOSKA Kalina
Faculty of Philosophy, Ss. Cyril and Methodius University in Skopje

PSYCHOLOGICAL EDUCATIONAL INNOVATIONS: DO STUDENTS SUCCESSFULLY FACE FAILURES AND CHALLENGES?

Abstract: Rapid economic and social development relies on technological innovations. In addition to technical knowledge, innovation requires critical thinking, creativity, problem-solving, and communication skills. The main challenge of education in STEM areas is to develop a complete set of skills. From a pedagogical point of view, the question of whether students receive support on how to face failures and challenges arises successfully. The purpose of this research is to assess and understand how students experience coping with failure in mastering subjects in the STEM context. The research included 109 respondents, undergraduate students of STEM programs. The results showed that the most common styles for dealing with stress are problem-solving by using direct action, emotional regulation, problem-solving by planning, information seeking, and self-blaming. The least commonly used styles for coping with stress were acceptance, helplessness, denial, and humor. The results indicate the need of developing skills to help students avoid or overcome inappropriate ways of coping with failures and challenges, such as depression, withdrawal, anxiety, and dropout. Innovations in education will include encouraging and developing appropriate coping strategies so the STEM lectures and learning will become more effective, relevant, and enjoyable.

Keywords: Coping styles, Challenges, Failures, STEM context

Introduction

The world is faced with an increasing number of challenges within the economic, political and environmental spheres, which imposes a need for creative and innovative solutions by future engineers. Providing sustainable and resilient resolutions is underlined by all of the UN Sustainable Development Goals (National Academy of Engineering 2004; United Nations 2019a; according to Dyer, 2019). Leaders from the economy, industry, and politics agree that it is necessary to take the initiative to develop the appropriate competencies of students, and the cocoa future workforce by promoting deeper learning through problem-solving and collaboration skills (Alina, 2018). Scientific problems and challenges increase their complexity so that the new generations of scientists will have to face the failures and challenges for successfully conducting research. Innovative scientists have to be resilient problem solvers. The ability to iterate, solve problems and coordinate obstacles and failures are essential skills of experts, which are certainly related to mental health.

Psychological problems among students are an important general concern in society. The mental health of students is often defined as a crisis, and the need for counselling and treatments has increased (Wu, Yu & Wu, 2020). STEM students do not need more STEM content knowledge; instead, they need twenty-first-century skills to be able to communicate their ideas, understand corporate and personal ethics develop social skills and respect a culturally diverse team of peers (McGunagle, & Zizka, 2020). Discovering what are the specific coping mechanisms used by students in stim contexts when facing challenges and failures will allow a better understanding of why students behave in a certain way and will encourage taking actions to improve their well-being and achieve success in the future.

STEM Context

Today, STEM studies are facing great challenges in the digital revolution where technology and science play a major role. STEM education has been lately conceptualized (Navarro-Espinosa,

et al., 2021) as an acronym for the discipline of Science, Technology, Engineering, and Mathematics. STEM education produces scientists and engineers who continue the research and development that is central to the economic growth of any country. Likewise, individuals who will successfully graduate with undergraduate studies in the STEM context are expected to be technologically proficient workers who keep abreast of rapidly developing scientific and engineering innovations and scientifically literate voters and citizens who make intelligent decisions about public policy and who understand the world around them (APA, 2022).

Failure and Challenges

Failure is the gap between the expected outcomes or the desired outcome and what is ultimately experienced (Cannon and Edmondson, 2005; according to Henry et. al., 2019). Failure is defined as the inability to achieve the requirements determined by the achievement context resulting in an unrealized goal (Henry et. al., 2019). Achievement contexts contain tasks to be performed, include an assessment of how tasks are performed according to, set standards or expectations aimed at achieving the goal, and certain competencies that are required to perform the task according to the appropriate standards (Cacciotti, 2015; according to Henry et. al., 2019). When the individual does not successfully complete the task they are considered to have experienced failure. A distinction is made between error and failure. Errors are defined as discrepancies between the current and the desired state, that is, deviation from the determined standard (Frese & Zapf, 1994; according to Tulis, Steuer & Dresel, 2016). In contrast, failure is missing the target by focusing on the consequences, and in general, it is more than a perceived discrepancy (Zhao & Olivera, 2006; according to Tulis, Steuer & Dresel, 2016). It is important to note that every error can be interpreted as a failure. Whether an error will be perceived as a failure depends on contextual factors, such as social norms and the personal characteristics of the learner (Tulis, Steuer & Dresel, 2016). Challenge is set as a context for achieving a certain goal with the possibility of certain failure (Henry et. al., 2019). Challenge in an academic context is defined as demanding high achievement (Braxton, 1993; according to St. Clair, & Hackett, 2012), as stimulating students to make every effort for superiority (Unks, 1979; according to St. Clair, K. L., & Hackett), and as encouraging students towards active learning, tests students' skills and knowledge to a certain level where there is a possibility of failure (Henry et. al., 2019).

Coping Styles

Coping is defined as the thoughts and behaviors mobilized to manage internal and external stressful situations (Folkman, & Moskowitz, 2004). There are numerous taxonomies of categorization of coping responses. In general, coping is divided into reactive coping, namely the reaction that occurs after the stressor, and proactive coping, which aims to neutralize stressors that will occur in the future (Algorani, & Gupta, 2022). Also, there are four major categories of coping according to Folkman & Moskowitz (2004). The problem-focused coping is a task-oriented coping style (Wu, Yu & Wu, 2020). It addresses the problem causing the distress. Examples of this style include active coping, planning, restraint coping, and suppression of competing activities. The emotion-focused coping aims to reduce the negative emotions associated with the problem. Examples of this style include positive reframing, acceptance, turning to religion, and humor. Meaning-focused coping is when an individual uses cognitive strategies to derive and manage the meaning of the situation and social coping or support seeking in which an individual reduces stress by seeking emotional or instrumental support from their community. Roskies, Louis-Guerin, and Fournier (1993) discussed six different coping strategies to reduce stress, such as emotional discharge, cognitive avoidance disengagement, cognitive redefinition, direct action, and direct action to improve future prospects.

Coping responses within STEM can also be considered adaptive or maladaptive. Responses are adaptive when they support both student well-being and furthering their STEM goals and maladaptive when they exacerbate threats to well-being and impede progress toward goals (Henry et. al., 2022). Research on undergraduate students in the STEM context and adaptability to facing setbacks and threats to their well-being is in its infancy.

Based on the research of Henry at. al. (2022) there is a coping style model, consisting of problem-solving, challenge engagement, challenge avoiding, support seeking, cognitive restructuring, humor, and self-blame. Facing the challenge or failure by turning to problem-solving, which includes recognizing and regulating emotions, trying to understand the causes of the problem, and finding a plan or strategy for action (Skinner et al., 2003) is a copying style. Challenge engagement covers activities that are oriented toward problem-solving, including recognizing and regulating emotions, finding out what are the causes of the problem, and determining a plan or strategy of action to improve the situation (Henry et. al., 2019). Cognitive restructuring is an effort to make reconstruction of a stressful experience or problem by focusing on its positive aspects and seeing it in a more positive light (Skinner et al., 2003). People try to use the social resources that are available as support in solving the problem and alleviating the stress or try to reduce the negative feelings that are associated with the problem (Skinner et al., 2003). There are attempts to avoid situations or contexts related to the problem, to actually deny the problem, or to run away from the problem which is characterized as escape or denial (Skinner et al., 2003). Disengagement is a set of activities to relieve the problem without exerting effort, while no effort is made to solve the problem and to initiate it in alternative activities that allow mental disconnection (Skinner et al., 2003). Challenge-avoiding means not becoming active in solving the problem, persistently denying that the stressor has occurred, and avoiding anything that might lead to the need to engage (Henry et. al., 2019). Self-blame is focused only on the negative aspects of the stressful situation, constant self-blame, constant fear, and thoughts that everything will be disastrous (Skinner et al., 2003).

Henry et. al. (2019) distinguished between adaptive academic coping as coping that enables students to maintain their well-being and successfully move toward high academic performance and maladaptive academic coping as coping that has the potential to disrupt student well-being and thereby prevent students from achieving high academic performance. Accordingly, problem-solving, support seeking, challenge engagement, and cognitive restructuring are defined as adaptive academic coping, while challenge avoiding, self-blame, and escape are defined as maladaptive academic coping.

Very little is known and researched about stressors in the university environment from a student perspective. Baik, Larcombe, and Brooker (2019) tried to find out what needs to be done to improve the well-being of students. According to the students' recommendations, seven categories were made: academic teachers and teaching practices; student services and support; environment, culture, and communication; course design; program administration; assessment; and student society activities. Based on the research findings, it is concluded that it is important to work toward encouraging a sense of inclusion and empowerment of students to improve their well-being.

Few studies have examined undergraduate students' mental state and coping mechanisms for failure. Some research has shown that older undergraduate students are more likely to use positive coping strategies than younger undergraduates. Female and medical students are more likely than male and non-medical students to adopt positive coping styles (Monteiro, Balogun, Oratile, 2014). Findings suggest that psychological education and health promotion programs aimed at strengthening psychological resilience in undergraduate students can help foster positive coping styles and improve mental health and psychological well-being in students (Wu, Yu & Wu, 2020).

The purpose of this study is to examine the coping mechanisms of facing failure among undergraduate students in a STEM context. From a pedagogical perspective, let's ask ourselves if

we are supporting all students to learn how to successfully thrive with failure and challenge? How are these skills developed in students in a STEM context?

Participants

The study used a sample of 109 undergraduate STEM students enrolled in the online anonymized survey. Participants were invited to participate in this study in spring 2022. Majority of students identified as female 87 (79.82%), and 22 (20.18%) as male. 89% of the students were aged between 21 and 23 years. The distribution by degree course was as follows: 89 (81.7%) were studying at FINKI (Faculty of computer science and engineering), 11 (10.09%) were studying mathematics, physics, and chemistry at the Faculty of Natural Sciences and Mathematics and 9 (8.26%) participants studied psychology at the Faculty of Philosophy, all of them at the Ss. Cyril and Methodius University-Skopje in the Republic of North Macedonia.

Instruments

STEM-COPE, Coping styles Instrument constructed by Henry, M.A., Shorter, S., Charkoudian, L.K. et al., (2022) was used in this survey. There was an initial explanatory passage about the understanding challenge and failure in the STEM context. Students responded to 23 survey items on a four-point Likert response scale including not at all, rarely, occasionally, and a lot. The psychometrics were acceptable, the Cronbach alpha was in a range from 0.69 to 0.89. After completing survey items students answered relevant demographic questions.

Procedure

Before the beginning of the study, students were informed about the objectives of the study and were asked to patriciate through their students' email addresses. They were assured of anonymity and confidentiality of the responses. Also, they were told that answering the questionnaire was voluntary and there are no consequences. The questionnaire was administrated online without a time limit. The data analyses were made using the statistical program SPSS 26.

Results

Table 1

Descriptive statistics of the adaptive coping styles and maladaptive coping styles among male and female undergraduate students of different ages

Adaptive coping	Gender	Age	Mean	SD	N
	Male	18-20	46.50	13.43	2
		21-23	43.89	5.67	19
		27+	40		1
		Total	**43,95**	**6.12**	**22**
	Female	18-20	43.50	7.58	6
		21-23	46.99	5.80	78
		24-26	47.33	8.62	3
		Total	**46.76**	**5.99**	**87**
Maladaptive coping	Male	18-20	20.50	3.53	2
		21-23	19.63	3.83	19

		27+	23.00		1
		Total	**19.86**	**3.71**	**22**
	Female	18-20	19.50	3.78	6
		21-23	19.89	3.98	78
		24-26	21.00	2.00	3
		Total	**19.91**	**3.99**	**87**

According to the obtained data, males and females do not differ in terms of adaptive coping with academic challenges and failures. Among male students, the adaptive academic coping decreases over the years, in contrast to the female students of undergraduate studies in the STIM contexts, where there is an improvement in the adaptive coping with challenges and failures.

Table 2
Multivariate Tests

Effect		**Value**	**F**	**Hypothesis df**	**Error df**	**Sig.**
Intercept	Pillai's Trace	.911	522.156[b]	2.000	102.000	.000
	Wilks' Lambda	.089	522.156[b]	2.000	102.000	.000
	Hotelling's Trace	10.238	522.156[b]	2.000	102.000	.000
	Roy's Largest Root	10.238	522.156[b]	2.000	102.000	.000
Gender	Pillai's Trace	.000	.024[b]	2.000	102.000	.976
	Wilks' Lambda	1.000	.024[b]	2.000	102.000	.976
	Hotelling's Trace	.000	.024[b]	2.000	102.000	.976
	Roy's Largest Root	.000	.024[b]	2.000	102.000	.976
Age	Pillai's Trace	.019	.337	6.000	206.000	.917
	Wilks' Lambda	.981	.334[b]	6.000	204.000	.919
	Hotelling's Trace	.020	.331	6.000	202.000	.920
	Roy's Largest Root	.014	.474[c]	3.000	103.000	.701
Gender*Age	Pillai's Trace	.014	.744[b]	2.000	102.000	.478
	Wilks' Lambda	.986	.744[b]	2.000	102.000	.478
	Hotelling's Trace	.015	.744[b]	2.000	102.000	.478
	Roy's Largest Root	.015	.744[b]	2.000	102.000	.478
a. Design: Intercept + v2 + v3 + v2 * v3						
b. Exact statistic						
c. The statistic is an upper bound on F that yields a lower bound on the significance level.						

The investigation of the differences in terms of gender and age group in the use of adaptive academic coping and maladaptive academic coping among undergraduate students was performed using MANOVA. The results are presented in Table 3. No statistically significant difference was found between male and female students in the use of adaptive $F(1, 102)=0.00$, $p=0.99$. There

is no statistically significant difference between males and females using maladaptive academic coping. Also, no significant differences were found in relation to age groups for adaptive academic coping F (3,99)=0.35, p=0.79 and maladaptive academic coping F(3, 99)=0.32, p=0.81

Table 3
Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Adaptive	235.511[a]	5	47.102	1.283	.277
	Maladaptive	16.289[b]	5	3.258	.212	.957
Intercept	Adaptive	26063.032	1	26063.032	709.912	.000
	Maladaptive	5674.711	1	5674.711	370.027	.000
Gender	Adaptive	.012	1	.012	.000	.986
	Maladaptive	.736	1	.736	.048	.827
Age	Adaptive	38.530	3	12.843	.350	.789
	Maladaptive	14.603	3	4.868	.317	.813
Gender*Age	Adaptive	50.699	1	50.699	1.381	.243
	Maladaptive	2.189	1	2.189	.143	.706
Error	Adaptive	3781.443	103	36.713		
	Maladaptive	1579.601	103	15.336		
Total	Adaptive	236597.000	109			
	Maladaptive	44757.000	109			
Corrected Total	Adaptive	4016.954	108			
	Maladaptive	1595.890	108			
a. R Squared = .059 (Adjusted R Squared = .013)						
b. R Squared = .010 (Adjusted R Squared = -.038)						

Implications of the Results of the Study

The identification of the coping styles among undergraduate students in the STEM context will be useful for further policy-making toward redefining study programs and teaching procedures in higher education in a STEM context. Also, this study would be of great value to the academic staff to develop a framework for incorporating the development of coping styles and 21st-century skills, such as critical thinking, problem-solving, and information literacy in the STEM curriculum. Developing these skills among students in the STEM context will not only contribute to creating a well-prepared workforce for the future but will contribute to the development of life skills that will help them succeed.

Within universities, the programs are traditional and continue to teach the traditional curriculum in traditional ways at the cost of neglecting the knowledge and skills necessary for today's labor market and the market of the future (Bunshaf, et. al., 2013; McGunagle, & Zizka, 2020).

Limitations of the Study and Ideas for Future Research

The sample of students was not randomly selected. They voluntarily participated in this survey. Self-selection of the participants to take part in the study may suggest biased results. Also, the number of participants should be higher and from many different disciplines. The study could be PROSIRI with qualitative research including interviews directly conducted with STEM students about their interpretation of the coping styles with challenges and failure, and STEM students to give directions about the gap in their skills in the real world.

Discussion

There is a question of what to do considering undergraduate students in a steamy context, where failure is common but cool still expect quick success (Henry et. al., 2019). Based on the obtained data, it can be seen that students use more adaptive coping with academic challenges and failures, but the conclusion is reached that it is inappropriate to take the initiative to improve them. These results may be due to a desire to provide socially desirable responses and portray them in a better light. Above all, interventions in study programs are needed, to form and take interventions that will help undergraduate students in a supportive context to take on challenges and respond appropriately to failures. Of course, all this is necessary to keep students in the STEM fields and to develop into future successful scientists who will be properly adapted to their environment. Hence the inclusion of psychology as a subject in study programs in the STEM context is more than necessary. The psychological knowledge could develop educational techniques that facilitate students' mathematical and scientific learning and that help people address everyday problems by enhancing analytical skills, scientific literacy, and problem-solving strategies (APA, 2022). Psychology represents an interdisciplinary bridge that helps in the acquisition of STEM literacy by combining all dimensions of STEM as well as the ability of psychology to facilitate the process of mastering STEM programs (APA, 2022).

This paper provides a basis for encouraging further research on students and their well-being and highlights the need to take action on understanding the relationship between interpersonal factors and student success and well-being in a STEM context. It is necessary for STEM education that students will be able to transfer their knowledge across different disciplines and creatively solve problems in other contexts.

References

Allina, B. (2018), *The development of STEAM educational policy to promote student creativity and social empowerment*, Arts Education Policy Review, Vol. 119 No. 2, pp. 77-87

Algorani EB, Gupta V. Coping Mechanisms. [Updated 2022 Apr 28]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK559031/

American Psychological Association. (2022, April 20). *Psychology as a Core Science, Technology, Engineering and Mathematics Discipline.* https://www.apa.org/pubs/reports/stem-discipline

Baik, C., Larcombe, W. & Brooker, A. (2019). How universities can enhance student mental well-being: the student perspective, *Higher Education Research & Development*, 38:4, 674-687, DOI: 10.1080/07294360.2019.1576596

Bunshaft, A., Curtis-Fink, J., Gerstein, A., Boyington, D., Edwards, T. and Jacobson, C. (2015), "Focus on employability skills for STEM workers. Points to experiential learning", STEM connector's STEM Innovation Task Force, available at: www.STEMconnector.org.

Cooper, K. M., Hendrix, T., Stephens, M. D., Cala, J. M., Mahrer, K., Krieg, A., et al. (2018). To be funny or not to be funny: Gender diferences in student perceptions of instructor humor in college science courses. *PLoS ONE*, 13(8), e0201258

Evans, T., Klymchuk, S., Murphy, P.E.L., Novak, J., Stephens, J. & Thomas, M. (2022). Engagement of undergraduate STEM students: the influence of non-routine problems, *Higher Education Research & Development*, 41:1, 146-162, DOI: 10.1080/07294360.2020.1835838

Folkman S. & Moskowitz, J. T. (2004). Coping: pitfalls and promise. *Annu Rev Psycho*l; 55:745-74.
Henry, M.A., Shorter, S., Charkoudian, L.K., Heemstra, J.M., Le, B., & Corwin, L.A. (2022). Coping behavior versus coping style: characterizing a measure of coping in undergraduate STEM contexts. *International Journal of STEM Education, 9*, 1-26.
Henry, M. A., Shorter, S., Charkoudian, L., Heemstra, J. M., & Corwin, L. A. (2019). FAIL is not a four-letter word: A theoretical framework for exploring undergraduate students' approaches to academic challenge and responses to failure in STEM learning environments. *CBE—Life Sciences Education*, 18(1), ar11. https://doi.org/10.1187/cbe.18-06-0108
McGunagle, D.M., & Zizka, L. (2020). Employability skills for 21st-century STEM students: the employers' perspective. *Higher Education, Skills and Work-based Learning, 10*, 591-606.
Monteiro, N.M., Balogun, S.K., Oratile, K.N. (2014). Managing stress: the influence of gender, age and emotion regulation on coping among university students in Botswana. *Int J Adolesc Youth*, 19:153–73.
Navarro-Espinosa, J. A., Vaquero-Abellán, M., Perea-Moreno, A. J., Pedrós-Pérez, G., Aparicio-Martínez, P., & Martínez-Jiménez, M. P. (2021). The Influence of Technology on Mental Well-Being of STEM Teachers at University Level: COVID-19 as a Stressor. *International journal of environmental research and public health*, *18*(18), 9605. https://doi.org/10.3390/ijerph18189605
Roskies E, Louis-Guerin C, Fournier C. (1993). Coping with job insecurity: How does personality make a difference?. *Journal of Organizational Behavior*; 14:617-630.
St. Clair, K. L., & Hackett, P. M. W. (2012). Academinc challenge: Its meaning for college students and faculty. *Journal on Centers for Teaching and Learning*, 4, 101-117.
Tulis, M., Steuer, G., & Dresel, M. (2016). Learning from errors: A model of individual processes. *Frontline Learning Research*, *4*(2), 12–26
Wu, Y., Yu, W., Wu, X. et al. (2020). Psychological resilience and positive coping styles among Chinese undergraduate students: a cross-sectional study. *BMC Psychol* **8,** 79 https://doi.org/10.1186/s40359-020-00444-y

STEFANOVSKA Divna
Special educator, Resen, Macedonia
AJDINSKI Goran
Faculty of Philosophy- Institute of Special Education and Rehabilitation, Skopje

PREPARING THE REGULAR PRIMARY SCHOOLS WITH INCLUSION OF ALL STUDENTS WITH DISABILITIES

Abstract: With the transformation of the special schools into resource centers and the transfer of all students with disabilities to the regular primary schools, we come to a very important question; is our country ready for the whole process of inclusion of all students with disabilities?

The subject of this research is the determination of the preparedness of the educational system for implementation of inclusion for all students with disabilities in the regular primary schools in the Municipality of Resen. For this purpose, a research was conducted in all regular primary schools in the Municipality of Resen and it involved 129 teachers and professional associates.

The purpose of the research is to determine whether has been created a inclusive climate and inclusive policy for the inclusion of all students with disabilities in the educational process in the regular primary schools, as well as to determine whether the educational system is ready for inclusive education.

The research enabled us to see the overall state in which the regular primary schools are. The results of this research are that the regular primary schools in the Municipality of Resen are not prepared for the inclusion of all students with disabilities, and we still need to work on removing the architectural barriers and reinforce the capacities of the professional associates and train the teachers to work with students with special needs.