Technical university students’ readiness for sustainable learning in terms of self-directed learning

Natalja V Dyorina1, Petr Yu Romanov2*, Elena A Gasanenko1, and Georgy V Tokmazov3

1 Institute for Humanities Education, Nosov Magnitogorsk State Technical University, 38 Lenin Ave., Magnitogorsk, 455000, Russian Federation
2 Institute of Natural Science and Standardization, Nosov Magnitogorsk State Technical University, 38 Lenin Ave., Magnitogorsk, 455000, Russian Federation
3 Admiral Ushakov Maritime State University, 93 Lenin Ave., Novorossiysk, 353924, Russian Federation

Abstract. The article analyzes the readiness of technical university students for sustainable learning in terms of self-oriented learning based on the conducted research data. The authors conducted a respondents’ survey, in which they studied the technical university students’ perception of the self-oriented learning basic indicators. The obtained data analysis showed how the technical university students understand and develop their readiness for self-oriented learning. The results of the research work confirm that the technical university students are ready for sustainable learning partially. Despite the fact that the technical university students have the necessary digital competencies for effective participation in the learning process, the data obtained indicate the tendency of the technical university students to procrastinate in the learning process. The authors of the research work noted the importance of transformative learning in the sustainable development of the technical university students, analysed possible lack of time management skills problems and tendency to procrastination, which may have been contributed by the high level of stress caused by the negative effects of the COVID-19 pandemic and the unplanned transition to online learning. In recent decades, higher education has increasingly focused on student self-orientation. Self-oriented learning is effective only if the technical university students are capable of self-oriented learning. Self-oriented students are able not only to manage their own learning, but also to take responsibility, understand and realize the significance of learning and cognitively control their learning. A facilitator is able to help learners become fully self-directed online learners.

1 Introduction

The world community has undergone a number of severe consequences associated with the COVID-19 pandemic, and the Russian society has not been able to avoid these consequences as well. The pandemic provoked a set of problems that went far beyond the medical sphere. Overcoming the consequences has become a key factor in the functioning of the economic, social, and educational spheres in Russia. As it turned out the current situation affected all educational organizations in the country. During the pandemic, in most cases, educational organizations were completely or partially closed, and many students were transferred to online learning. In such difficult conditions, educational organizations had to respond very quickly to the urge challenge and promptly review established educational practices at all levels of education, including higher education. At the same time, along with obvious challenges and problems, the new format of the educational paradigm provides a wide range of opportunities and prospects for the formation and improvement of modern educational systems, for which a critical situation is not a problem, but becomes a trigger for a new round of development.

According to N. Verbitskaya, L. Orinina’s recent studies have identified worrying trends related to the emergence of difficulties for university graduates who are not ready to enter the labour market. There is the absence or small enrolment of applicants for some educational programs, as well as those associated with worsening learning outcomes and a decrease in students’ interest in the educational process in general. The pandemic has already catalyzed rapid change in this area of education. It should be noted that higher education turned out to be the most resistant to the consequences and problems caused by the COVID-19 pandemic. Complex modern technologies are being quickly introduced into universities, so the transition to distance learning was quite successful. Digitalization everywhere contributed to the formation of technological skills among students, which played a positive role during the pandemic. The consequences of COVID-19 have affected the flexibility of students’ general cultural and professional competencies. Distance learning of students during the pandemic contributed to the formation of socially significant personality traits, caused the growth of the volunteer movement, and increased the social activity of students.
Researchers believe that the effects of the pandemic are contributing to the transformation of higher education and, as a result, require great attention and response. As practice shows, the educational activities of most universities during the pandemic received a powerful impetus to development, which could not always be implemented due to the current situation, when it is necessary to take the most adequate measures, for which educational organizations were not ready to face the challenge. It is necessary to plan and carry out a number of activities that take into account the specifics of the educational environment and support participants in the education system at all levels, since the pandemic had a negative impact on the physical and psychological well-being of participants in the educational process [1].

The educational process at the university is aimed at meeting the requirements of modern Russian society, which currently needs professional specialists; in connection with this, the task of educational organizations is to form among students, first, high culture; professional competencies, information and environmental literacy, legal and communicative culture. In this context, the educational environment of the university should contain several factors that contribute to the effective functioning of the educational process, where lifelong learning is a necessary attribute of creating a favorable educational environment. As practice shows, not all educational organizations and communities of technical universities, in particular, are successfully coping with the consequences of the pandemic, since a transition to such training is required where most of the educational resources must be in digital format; most of the students at technical universities were not ready for this form of education. First, students need to form the skills of self-orientation and self-organization in order to master the educational material in a new online format.

For the formation of self-orientation skills in a student at a technical university, it is necessary to realize the importance of possessing such skill, arising from the internal motivation of a student aimed at analyzing and developing his abilities, to achieve the highest possible level, which, according to a student at a technical university, he possesses. Lack of knowledge about one’s own potential may prevent a student at a technical university from realizing the fullness of his abilities. The potential of a student can be determined in the presence of a certain environment, conditions, other factors surrounding a person, which form a unique environment conducive to the full-fledged training of a professional. When studying the personality of a student at a technical university within the framework of self-orientation, special attention should be paid to such phenomena as self-development, self-realization of creative potential, social maturity of the individual. There is the need for self-development, self-improvement, actualization of acquired competencies, as well as objective and subjective factors that accompany the achievement of the heights of professionalism within the framework of the educational process.

The pandemic has challenged society, the education system and the participants in the educational process, students, and teachers largely. The answer to this challenge can be the development of students’ abilities for sustainable learning. The concept of sustainable learning is considered a relatively new area of pedagogical research. According to M. Khokhlova, E. Zhizhko, A. Goncharova, L. Kulikov [2,3], in the formation of the phenomenon of sustainable education, the main vectors of development were aimed at systematic changes in educational systems around the world, to stimulate economic development towards future prosperity and stability of society. Recent topical studies on the effectiveness of technical universities by N. Janmenjoy, M. Manohar, N. Bignaraj, S. Hanumantu, K. Korhan, S. Vimal [4], A. Tokarev [5] define sustainable learning as learning that persists fully. It can be transferred to other areas of life, and this goes beyond education at a technical university, because the student can have a meaningful learning experience outside the educational environment. Sustainable learning, like lifelong learning, goes beyond acquired knowledge and general cultural and professional competencies. Such experiences form the continuous, purposeful, stable development of the student’s ability to anticipate their future needs for knowledge, skills, and abilities. On the other hand, it is based on the idea of canceling knowledge that is no longer needed, which allows the learner to actively apply and form a new knowledge base.

It should be noted that the concept of sustainable learning as a pedagogical phenomenon has not been fully studied. There are few gaps in the field of the problem under study; one of such gaps is the lack of extensive pedagogical research aimed at studying the self-orientation of students at a technical university in the framework of sustainable learning in the educational process of the university. Now, the readiness of students at a technical university for sustainable learning in the framework of self-orientation has not been studied. The authors conducted the present study to fill this gap in the modern pedagogical field. This research work makes an undoubted contribution to this line of research.

The authors consider technical universities students’ readiness for sustainable learning in terms of their self-orientation. Self-orientation of students at a technical university in the process of continuous learning is interpreted by the researchers of this scientific work as a process of understanding by students of a technical university of their place in society, professional sphere and in choosing the professional orientation of a future technical specialist. With this approach to understanding the phenomenon of self-orientation, there is a need to improve the quality of education and self-education. Within the framework of this approach, it is necessary to implement continuous learning, which is the conductor that contributes to the achievement of the goal. Lifelong learning is characterized by a systematic and purposeful course of learning and contributes to an increase in the level of cognitive skills, forms the readiness of students at a technical university to realize themselves as individuals and determine their self-orientation. The presence of deep and strong general educational and professional knowledge of students serves as the
foundation of self-determination. Let us draw your attention to the fact that the study of lifelong learning as part of the self-orientation of students at a technical university is the first stage of an extensive one that makes it possible to cover the entire scope of work related to obtaining reliable results. Nosov Magnitogorsk State Technical University involved students from seven institutes and departments: Metallurgy, Mechanical Engineering and Materials Processing Institute, Mining Engineering and Transport Institute, Power Engineering and Automated Systems Institute, Civil Engineering, Architecture and Arts Institute, Economics and Management Institute. They include the Institute for the Humanities, Department of Social Work and Psycho-Pedagogical Education, Institute of Natural Science and Standardization, Institute of Elite Programs and Open Education. The purpose of this study is to determine the readiness of students at a technical university for sustainable learning through self-orientation. The set goal will be achieved subject to the implementation of the following tasks: analysis of the degree of self-orientation of students at a technical university by studying their views on the indicators of self-orientation of education. The metrics contain elements such as goal setting, technical readiness, time management, procrastination control, fixation, class preparation, research skills, online learning readiness, exam readiness, and the ability to manage oneself in a stressful situation. These identify the difficulties that students face when doing independent work.

2 Materials and Methods

Pedagogical research is currently aimed at developing current trends in the field of higher education and, in particular, special attention is paid to technical universities, in which the humanitarian component needs to be expanded and strengthened. The researchers found that a technical university should contribute to the formation of a sustainable educational environment for the transition of higher education from a learning process based on providing students at a technical university with the necessary professional competencies to a learning process (not only with professional competencies, but also with general cultural ones). That develops students' skills to analyze the basic needs of education, compose and manage its educational trajectory, develop acquired competencies after leaving the educational process. Sustainable learning in the process of implementation is associated with the progressive acquisition of new knowledge, general cultural and professional competencies, technologies, professionally significant personal qualities of technical university students.

Sustainable learning has a mechanism based on the principles of continuity and sustainability of the educational process, which can be considered as the preservation of the results (general cultural and professional competencies) of passing through the learning stages with the possibility of further advancement in professional development with the accumulated potential. Compliance with the principle of continuity in the process of technical university students teaching ensures the unity of the theoretical and practical educational aspects. The content of theoretical knowledge at each stage of the learning process should correspond to the acquired practical experience and the degree of readiness for the transformation of a future technical specialist personality. The formation of competencies is achieved by building a single educational development space in the system of higher education. Sustainable learning expands the possibilities of learning in higher education, but at the same time requires a more flexible approach to the forms and structures of the educational paradigm that implements educational programs.

The implementation of the concept of continuous education actualizes several theoretical problems and practical tasks of organizing higher education. In modern conditions, continuous learning is a necessity for every socially active member of society since it provides a person with the opportunity to consciously implement vital projects. Sustainable education does not constitute an independent level or link in the education system and meets the educational needs of students, society, and the state, which cannot be satisfied within the legally established levels. At the same time, sustainable education covers all parts of the higher education system, being its integral part, and represents a sphere of educational activity comparable in value to the sphere of basic education.

In this regard, sustainable learning certainly plays an important role. Regarding higher education, transformational learning is a multifaceted problem that affects the entire complex of relations in the higher education system. An important role in its solution is played by organizational models of educational activities, designed to improve the quality of training of future specialists. Transformational learning and development are an attempt to answer many questions. The concept itself is in the process of formation and, perhaps, many issues will seem controversial and ambiguous. But, on the other hand, it makes you think and move away from the usual, well-established dogmas in the training and development of personnel. Transformational learning can be seen as a type of sustainable learning, since it is based on the active participation of students at a technical university in the learning process, aimed at an active and conscious understanding of the meaning of the material being studied. According to P. Bloom, G. Dees [6], this requires continuous reflection aimed at understanding the result obtained and how it is possible to improve the result obtained. Thus, it can be considered as a type of education that requires an effective transformation of existing ways of perceiving the picture of the world and deep reflection to enable students to go beyond the established practice. These prepare future specialists for an adequate perception of the ongoing changes in the educational space and conscious setting of goals and objectives, arising in educational and professional activities.
The conducted analysis of scientific sources by N. Jammenjoy, M. Manohar, N. Bighnaraj, S. Hanumanthu, C. Korhan, S. Vimal, A. Tokarev, P. Bloom, G. Dees, N. Dyorina, L. Savva, R. Novoselov, N. Burkšaitienė, R. Lescinskij, J. Suchanova, J. Šliogerienė, E. Bryazgunova shows that sustainability of higher education can be achieved by making changes in curricula and educational plans [4–9]. G. Gibbs believes [10] that the development of technical university students’ sustainable development competencies such as problem solving, critical and creative thinking, action competence, and systemic thinking, along with the implementation of pedagogical methods, contribute to transformative learning.

According to the leading theorist of transformative or transformative learning, J. Mezirow [11], transformative learning is seen as a process of transforming problematic frames of reference – sets of fixed assumptions and expectations (mind habits, viewpoints, mental attitudes) – to make them more inclusive, discriminating, open, aware, and emotionally transformative [11]. According to E. Dudina, the distinction between instrumental and communicative learning is central to transformative learning [12]. The first is understood as learning consisting of fixing the control and management of the environment with an emphasis on reasonable expectation and performance, and the second refers to understanding what a person means when he is in the process of communication. This awareness includes understanding the judgments, decisions made, motives and professionalism of the interlocutor. Similarly, E. Bataeva [13] notes that directed-meaningful teacher-provided learning of information transfer namely the analysis and interpretation of phenomena and phenomena that do not need a deep level of awareness, because it does not question the assumptions or beliefs of students at technical universities. It should be noted that engineering students are encouraged to consciously evaluate their assumptions and beliefs if they are engaging in transformative learning.

The transformative learning nature analysis by S. Sterling [14] relies on Bateson’s model of three levels of learning and we note that the concept of transformative learning can be understood in two ways. On the one hand, it can be viewed as learning, in which there is a transition from the first learning level to the second learning level. On the other hand, it can be understood as learning characterized by a profound transition to a third level of learning, also called epistemic learning. This makes transformative learning particularly relevant to the development of sustainable student learning in higher education.

Of all the teaching concepts of higher education, the concept of transformational learning has gained the most popularity in recent years. Transformational learning is understood as the social process of constructing and appropriating by the subject of new interpretations of the meaning of his experience and accepting these interpretations as a guide to action. A review of the relevant literature shows that to achieve a shift toward transformative learning in higher education, the role of educators and the conditions created by educators that are conducive to change are crucial. J. Mezirow recognizes that an educator’s primary professional goal is to facilitate the development of the diverse skills, habits of mind, disposition, and will of the learner so that he or she becomes a more active and rational student. According to the scientist, for transformational learning it is necessary not only to provoke new meanings and interpretations in the subject, activating a critical reassessment of his experience, but also to promote his active actions in accordance with these new meanings and interpretations. In general, mindfulness and awareness take a relevant place in the concept of transformational learning. Thus, the most significant transformations in the learning process are the transformations of self-determination and self-description. They are adjoined (in terms of importance for understanding and action) in the transformation of life prospects, the subject’s ideas about a possible and desirable future [11].

This means that teaching should be aimed at supporting and encouraging the learner to adopt his approach to learning, which requires active participation and reflection on learning, constraining an individual trajectory and achievements. Transformative learning can promote empathy by getting students to acknowledge and seriously consider different points of view. In the process of such training, it forms critical thinking, which includes a critical analysis of the acquired information. The process of transformational learning can facilitate discourse by encouraging students to share points of view that may challenge existing beliefs.

Consequently, the results of such learning reflect a deep understanding of what has been learnt and are suitable from the perspective of some researchers for sustainable development (E. Bataeva, S. Sterling [13, 14]).

Scientific sources also demonstrate that due to the complexity of change that is a prerequisite for transformative learning in higher education, planning, facilitating, and implementing this change is a challenging task for all parties involved, including higher education institutions, academics, and students. On the one hand, as N. Burkšaitienė, R. Lescinskij, J. Suchanova, J. Šliogerienė, E. Bryazgunova believe, the planning process involves significant educational preparation, such as making holistic changes in curricula and shaping the readiness of universities to implement transformative learning [8, 9]. On the other hand, to support students and facilitate the transition to transformative learning, teachers themselves must acquire the necessary competencies and be ready to accept changes in higher education didactics. For example, from the scientists’ point of view, they must be ready to implement the so-called multi-method approach to learning, based on different teaching methods (both didactic and constructivist) aimed at developing students’ competencies in the field of sustainable development [9]. Finally, implementing change is also challenging for students, as it may cause their resistance or aversion to change [8]. Thus, to successfully move towards transformative learning, learners must be encouraged to
actively engage in the learning process and be trained to orient their learning. This can lead to sustainable learning, which involves continuous, focused, guided, responsive, and proactive learning, where the student effectively and flexibly builds and rebuilds their knowledge and skill base and competencies as circumstances change.

In recent decades, higher education has increasingly focused on students' self-oriented learning, as it ensures successful participation in the learning process along with the professional success of a future professional. Students are assumed to be self-oriented learning participants in the educational process. However, literature review evidence suggests the need to support their development as such participants. Some domestic and foreign researchers (A. Tokarev, N. Ogannisyan, A.Voronin, I. Peshkova, O. Zyateva) are convinced that self-orientation is effective only if students develop a self-regulated learning approach.

Motivations, interest, inclinations of students are the sources of knowledge acquisition, as a "model", the experience of which students learn, as a participant in the process of acquiring their own experience by students. Motivations, interest, inclinations of students are the key and most expensive resource that ensures the effectiveness of education [17].

From H.E. Muse’s point of view [18], self-orientation is a term that considers external factors that motivate learners to take primary responsibility as well as internal factors that incline learners to take responsibility for the learning process. According to M. Galkina’s position, self-oriented learning can be considered as any accumulation of knowledge, skill development, task performance or self-development that the learner chooses independently, using a personal approach or technique in any conditions at an appropriate time [19].

According to S.D. Brookfield [20], the driving force behind self-orientation is the importance of the learner's ability to exercise control over all educational decisions. Thus, the student himself sets the goals of learning and determines the necessary resources, methods, and criteria for assessing his degree of success. The author also points out that learners need to develop the ability to self-oriented learning, which allows them to determine what knowledge is needed and how it can be obtained.

### 3 Results and Discussion

The research sample (n = 208) consisted of second- and third-year students receiving education in various fields, including technical, social and humanities in seven institutes of Nosov Magnitogorsk State Technical university. Of the total number of the respondents, 60.8% were second-year students, and 39.2% were fourth-year students. Slightly less than 70% of the respondents had some work experience (1–5 years).

The questionnaire consisted of 55 questions covering 11 self-oriented learning indicators that measured the technical university students' perceived competence level in self-oriented learning. This study did not address questions related to technical university students' readiness for face-to-face classes/seminars, which pertained to the eleventh indicator because the respondents were studying online. Thus, ten indicators with 40 statements were selected for this study. In addition, several open-ended questions were included in the questionnaire to supplement the data. Responses to the open-ended questions will be analyzed and presented in subsequent papers.

A Likert scale (from 1 – strongly disagree to 7 – strongly agree) was used. In calculating the results, some values were inverted because some of the questions were presented in negative terms. The collected data were analyzed using SPSS software. Descriptive statistics were used to obtain sample and measurement summaries, correlation analysis was performed to determine relationships between variables and measures, and nonparametric tests (Chi-square, Mann-Whitney U test, Kruskal-Wallis H test) and the variance analysis were used to determine statistically significant differences. The significance threshold used in this study is \( \rho <0.05 \).

The Cronbach's alpha coefficient [21] was calculated to establish the consistency of the measures examined in this paper, and a high level of internal consistency was established (Cronbach's alpha = 0.88). Participant demographics regarding year of study, gender, or program of study were excluded from the calculation because they were not significant for the results of the study. The obtained data showed how students perceive their readiness for independent learning in terms of the following indicators: stress resistance, resistance to procrastination, classroom readiness, exam preparation, time management, goal setting, research ability, assignment preparation and technical readiness.

Most examined indicators of the study had scores above four (where four is neither agree nor disagree). The only notable exception in this regard was stress management (3.15). The results show that students were confident (score >5) in their ability to take notes (5.04), their ability to prepare assignments (5.18), and that their degree of technical proficiency was high (5.83). The latter result was unexpected, as the transition to online learning is usually associated with technical challenges by both researchers and practitioners.

Resistance to procrastination (4.21), class readiness (4.36), exam preparation (4.38), time management (4.53), goal setting (4.57), and research ability (4.81) scored between four and five, which may indicate a degree of student preparedness regarding these self-
orientation factors. However, it may also indicate lack of confidence and/or certain difficulties associated with these indicators. The data also suggest certain dependencies. In the time of online learning, assignment preparation and note-taking skills may be correlated with students' technical readiness. Statistical analysis also revealed a correlation between technical readiness and note-taking ability ($P = 0.236; \rho = 0.000$) and assignment preparation ($P = 0.249; \rho = 0.000$).

Technical university students’ perception of their ability to goal-setting, technical readiness, time management, and resistance to procrastination, exam preparation, and stress management were analyzed to identify variables related to student academic work on the computer and most significantly influenced by these indicators.

The results of the study showed statistically significant correlations, including a found statistically significant correlation between the main indicators of self-oriented learning such as goal setting, time management ($P = 0.595; \rho = 0.000$) and procrastination management ($P = 0.522; \rho = 0.000$). The goal-setting variable correlated with all variables, demonstrating that all indicators of self-oriented learning were strongly correlated and influenced students’ ability to take control of the learning process.

Statistical analysis (Spearman) of the goal setting indicator variables revealed the following ranking of the variables. These are goals to achieve from the program ($P = 0.726; \rho = 0.000$), not knowing why the program was chosen ($P = 0.715; \rho = 0.000$), “confused about what to study” ($P = 0.676; \rho = 0.000$), setting goals for assignments and exams ($P = 0.648; \rho = 0.000$). They include seeing the benefit of completing the curriculum ($P = 0.581$), and not keeping track of how much was accomplished ($P = 0.514; \rho = 0.000$).

It is noteworthy that technical readiness of students was not related to such indicators as time management, procrastination resistance, or stress management. A statistically significant correlation was found between the variable’s technical readiness and exam preparation ($P = 0.264; \rho = 0.000$), indicating that technical readiness is an important indicator for students’ independent work, especially during exam sessions.

Further analysis of the variables of the technical readiness indicator showed that the variables were arranged in the order. They have trouble using the computer ($P = 0.705; \rho = 0.000$), feel intimidated when using the Internet ($P = 0.693; \rho = 0.000$), “try to avoid academic work on the computer” ($P = 0.657; \rho = 0.000$). They feel comfortable using a computer ($P = 0.638; \rho = 0.000$), see life more interesting using the Internet ($P = 0.554; \rho = 0.000$), regularly use social networks ($P = 0.397; \rho = 0.000$), etc. The findings show that respondents feel comfortable using the equipment and software necessary for online learning, but do not always feel comfortable using social media.

An examination of the time management indicator showed that the variables were arranged as follows. These are finding time to study materials ($P = 0.737; \rho = 0.000$), devoting enough time to exams and assignments ($P = 0.706; \rho = 0.000$), not knowing what to study ($P = 0.640; \rho = 0.000$), “not handing in assignments on time” ($P = 0.634; \rho = 0.000$). These include planning what to study ($P = 0.598; \rho = 0.000$), and “feeling like there is too much to do” ($P = 0.552; \rho = 0.000$). Although students’ responses indicated that they were able to find time to study course materials, it seems that respondents also tended to put off completing some assignments until the end of the semester.

The variables attributed to the resistance to procrastination indicator were ranked as follows. They are “finding excuses not to study” ($P = 0.789; \rho = 0.000$), “constantly putting off assignments” ($P = 0.768; \rho = 0.000$), “preferring to do other things instead of studying” ($P = 0.748; \rho = 0.000$), “following the study schedule” ($P = 0.704; \rho = 0.000$), “persistence in completing unfinished assignments” ($P = 0.545; \rho = 0.000$), and “considering course study a priority” ($P = 0.526; \rho = 0.000$). These results are consistent with those from the previous indicator, i.e., students admit to putting off assignments until the end of the semester. This creates problems in time management.

The variables attributed to the preparation for exams indicator were ranked as follows. These are “confidence in taking tests and exams” ($P = 0.742; \rho = 0.000$), “poor performance on tests and exams” ($P = 0.716; \rho = 0.000$), “not understanding questions on tests and exams” ($P = 0.708; \rho = 0.000$), “ability to complete tests and exams” ($P = 0.686$), “ability to remember facts and knowledge” ($P = 0.620; \rho = 0.000$), and “nervousness during exams” ($P = 0.544; \rho = 0.000$). The sample consisted of second- and third-year students who should know how to prepare for exams at this point in their studies. The conducted questionnaire showed that the only indicator that differed significantly was “stress management;” therefore, each variable attributed to this indicator was analyzed separately.

The results showed that students who felt motivated while studying favored attending classes ($P = 0.610; \rho = 0.000$). However, despite being motivated, they also felt physically exhausted ($P = 0.410; \rho = 0.000$) or feared they were doing poorly on assignments ($P = 0.249; \rho = 0.000$). A statistically significant correlation was found between the variables measuring students’ fear of not doing well on assignments and not meeting expectations in their studies ($P = 0.579; \rho = 0.000$), suggesting that students were stressed while studying online and lost confidence if goals were not met. An analysis of the variables attributed to the “stress management” indicator showed that the variables were ranked as follows. These are “fear of failing” ($P = 0.634; \rho = 0.000$), “feeling motivated” ($P = 0.632; \rho = 0.000$), “demoralized when not meeting expectations” ($P = 0.572; \rho = 0.000$), “physically exhausted” ($P = 0.553; \rho = 0.000$), “like to attend class” ($P = 0.491; \rho = 0.000$), and “not worried about not passing” ($P = 0.388; \rho = 0.000$).

We agree that certain demographic factors may have influenced the dependencies explored above, one of which is students’ work experience. A variance analysis showed statistical significance of differences ($F = 4.208; \rho = 0.000$) between the variables describing how students monitor their level of achievement and how they feel about what needs to be learned during the course. The above variables are attributed to the “goal
setting” indicator. The variance analysis calculation also revealed a statistically significant relationship between the variables demonstrating whether students know what they should do during their studies and whether they understand what is required of them during tests and exams ($F = 12.117; \rho = 0.000$). These results indicate that respondents have difficulty controlling their learning and that they had troubles during tests and exams.

The students’ information perception presented in this work is worthy of discussion. Statistically significant differences ($P = 5.071; \rho = 0.000$) were found between variables describing how students cope with finding information for online presentations and how they felt when they did not meet expectations in their studies. The difficulty in finding the most important information leads to students not being able to cope with stress. The results of the study show that managing procrastination has also become a challenge for students since the transition to online learning. Students were expected to have some degree of autonomy, as the sample consisted of third- and fourth-year students. The relationships found between the variables measuring students’ attitudes toward procrastination and finding excuses for procrastination indicated that procrastination was a problematic issue that led to a failure to be self-oriented learning in their studies.

The study shows that most of the surveyed technical university students consider themselves the most prepared for those elements of independent learning which require a certain degree of technological preparation (technical readiness, preparation of tasks and ability to take notes), which means, as N. Romanova notes, mastering by technical university students such necessary technological skills for independent online learning [22]. This agrees with the results of other researchers S. Widodo, Y. Wirowo, W. Wagiran, T. Bouffard-Bouchard, S. Parent, S. Lavirée [23, 24], who found that students have the necessary skills, infrastructure and solutions for online learning. However, A. Moeller, J. Theiler, C. Wu [25] noted that even before the COVID-19 pandemic, technical readiness alone did not guarantee successful online learning. Such conclusions are consistent with the results of the present study.

The study showed that students were more confident in the time management and procrastination resistance indicators (4.88 and 4.86, respectively). In the present study, the data are taken from a survey conducted during the pandemic. Therefore, as might be expected, the average scores for these indicators are lower (4.53 and 4.21, respectively). It seems that students have an underdeveloped ability to be self-directed, which would allow them to stay on task and not be distracted from their studies. Many researchers [20–24] managed to reveal the dangerous influence of distractions on students during video lessons.

This conclusion is more relevant than ever because it is assumed that students are not distracted from their screens. Various distractions can lead to procrastination, and these pauses can lead to the undone assignments’ accumulation, which leads to psychological discomfort before and during the exam session. The results of this research suggest that participation in real organizations may affect positively certain aspects of self-directedness, such as time management and preparation for classes. Most participants in this study had some work experience (1 to 5 years), the authors believe that further research is in great need to determine the full impact of technical university students’ employment on their self-orientation.

### 4 Conclusion

The study allowed the authors to conclude that the study participants were only partially prepared for sustainable learning, since such learning requires an undeniably high level of self-orientation and is a transformative factor in the learning experience gained. This type of training requires a lot of effort from the participants, as well as flexibility and involvement in the process. As the results of the study show, the participants were best formed and implemented technical readiness, note-taking skills, and preparation for tasks, that is, in the process of the study, the participants most effectively coped with the tasks set from the point of view of their digital competencies. This willingness allows you to participate in the learning process at a qualitatively new level and plays a significant role in self-study. However, it should be kept in mind that while digital competencies are necessary for self-directed online learning, they do not by themselves allow for sustainable learning.

The analyzed data of the research results also lead to the conclusion that students had the necessary level of readiness for research activities, possessed a certain level of goal setting and problem-solving skills, had an idea, and successfully implemented time management skills. Also, the participants in the experiment showed their ability to effectively prepare for exams, had a well-formed readiness for online learning and showed stable resistance to procrastination. But it should be noted that the results of the study also indicate that students at a technical university faced several difficulties. In particular, self-oriented learning is a complex system, which, from the point of view of N.V. Dyorina, L.I. Savva et al. [26] require students to have effective goal-setting skills and be able to consistently and constructively solve tasks in order to achieve the goal. The results of the study indicate that some participants in the study did not have an adequate level of confidence in solving emerging difficulties in setting goals. In turn, other participants in the experiment did not have a proper idea of what kind of activity they were to be engaged in, what specifically needed to be done or what requirements must be met during the course. Some participants in the experiment did not record the progress made at different stages of the course, and some of the participants did not track the required time during tests or exams.

An analysis of the results of the study showed that some study participants had several difficulties in preparing for online learning, it was difficult for students to determine the most important information, they were also not able to cope with the proposed amount of
information, which correlated with a lack of ability to cope with stress. It should also be noted that some of the study participants had little or no effective time management skills, and some students procrastinated because the presence of distractions available on a large number of the Internet could cause some study participants to be unable to manage their time and keep control over the learning process.

The study revealed serious problems that arise in the participants of the experiment associated with the lack of skills that contribute to managing a stressful situation. Such results are an alarming sign to which close attention should be paid.

The data obtained during the study indicates that the negative effects of the COVID-19 pandemic and the unprepared transition of students to online learning contributed to the high level of stress of study participants, which was provoked by the fact that students at the time of the pandemic lacked basic skills to manage their time and resistance to procrastination. External stressful situation and internal instability and lack of stress resistance of students largely affected the independent work of students, which could have a negative impact on sustainable learning. In such a situation, the role of a university teacher, who should not only provide knowledge, but also, as an experienced mentor, should support students in a difficult stressful situation, is of great importance, since the lack of skills to deal with stress can significantly hinder progress towards sustainable learning. The conducted research confirms the competent opinion of such researchers as L.I. Savva, N.V. Dyorina, B. Zimmermann, E. Gladkov [26, 27, 28] which in turn actualizes the problem of self-orientation of students at a technical university in the process of professional training.

References

3. L. Kulikov, Society and Politics (St. Petersburg State University Publishing house, St. Petersburg, 2000)
11. J. Mezirow, New Directions for Adult and sustainable Education 74 (1997)
17. J. Mezirov, Self-directed Learning: From Theory to Practice (Jossey-bass, San Francisco, 1985)
21. L. Cronbach, Psychometrika 16 (1951)
