HOW TO MAKE LEARNING IN STEM MEANIGFUL FOR THE MILLENNIUM GENERATION

Dagnija Cedere, Rita Birzina, Tamara Pigozne
University of Latvia, Latvia
E-mail: dagnija.cedere@lu.lv, rita.birzina@lu.lv, tamara.pigozne@lu.lv

Elena Vasilevskaya
Belarusian State University, Republic of Belarus
E-mail: evas@tut.by

Abstract

The education of today more and more encounters the teaching and learning problems of young adults therefore it is topical to find out how to make the teaching/learning of the Millennium generation meaningful. This issue is especially important in STEM education. The survey involved Grade 10-12 students of Latvia, in total 256 students. Spearman's correlations and Kruskal-Wallis test were used in the data analysis. The obtained results showed that students- millennials as regards the learning of STEM subjects can be described as real-life oriented, digitally educated who want to participate actively in the teaching/learning process and who want to receive the feedback.
Keywords: *meaningful learning, Millennium generation, teaching and learning principles, STEM learning*.

Introduction

Qualitative education is needed for the person not only to adapt to the rapidly changing technologies but also to self-realize oneself successfully in the changing world of the future. The formation of the knowledge system, the acquisition of strategies, methods and methodologies, the skill to adapt to the new ways of acting and the communication means corresponding to them and not the scope of knowledge, its acquisition and transfer come to the foreground in the structure of the educational aims.

STEM education is important in the general education system (Hunter, 2013). STEM teaching and learning is complicated because the learner has to acquire higher order cognitive skills that are needed to comprehend the content of the subject and the application of knowledge in order to find solutions in real situations. World Economic Forum (2016) admits that students of the 21st century have to acquire not only academic knowledge but also collaboration, communication, and problem solving, which are some of the skills developed through social and emotional learning.

According to the generational theory also known as the Fourth Turning theory (Howe & Strauss, 1997), all students of today belong to the Millennium and Z generations (Generation Y, 1984-1999 year of birth) and Z generation (Generation Next or Z, 2000 - …… year of birth) or, summarizing the views expressed by Howell

and co-authors (2009), it can be considered that the target group of the present study is generation Y, known as the Millennial generation, referred also to individuals born between 1982 and 2005. Sometimes they are labelled as "Digital natives" and "Digital from birth" (Tapscott, 2009). Actually, the topical question is whether the school should ignore the peculiarities of the learning of the new generation considering that a particular group needs special authorities (Kirschner & De Bruyckere, 2017), or still look for new possibilities to develop the educational approach, which will be radically different from that of previous generations.

The common dominates in the opinions expressed by the researchers - students who were born in the age of digital media are fundamentally different from previous generations of students. These students have been labelled digital natives and have been ascribed the ability to cognitively process multiple sources of information simultaneously (i.e., they can multitask) (Kirschner & De Bruyckere, 2017). This means that modern students are characterized by "clip thinking" and active participation in the multimedia environment; however, at the same time they are characterized by weakening of analytical skills, inability to concentrate, computer dependency and worsening of social communication skills (Howell, Joad, Callahan, Servis, & Bonham, 2009; Jain, 2015).

Thus, rapid spread of scientific cognition inevitably raises new challenges for natural education (Lamanauskas, 2013), i.e., the necessity to find new approaches in the education process, to find an individual trajectory for each student - the route in education that would correspond to his/her peculiarities and needs (Sharples et al., 2016) so that STEM acquisition at school would become meaningful. Meaningful learning means that the student has to link the new information with the previous knowledge during an active teaching/learning process restructuring and reorganizing the obtained information so that new knowledge could be applied in different situations and contexts (Trifone, 2006). When organizing the teaching/learning process, the teacher should adjust to the needs of the Millennium generation, and in the acquisition of STEM focus on the development of higher order thinking, using technology in the context of learning, e-communication and collaboration.

As the millennials do not like the feeling of "being taught" and would make an effort to learn when they are the masters of the situation then it would be advisable to ensure the teaching/learning environment in order to stimulate self-directed learning, and the teacher should focus on an individualized teaching/learning process. Millennials prefer environments which are more inclusive, therefore they should be provided with strong peer to peer learning and group work. Millennials are focused on the acquisition of practical skills necessary for the concrete situation and for life therefore the acquisition of STEM should include practical activities related to the solution of real – life situations (Howell, Joad, Callahan, Servis, & Bonham, 2009; Jain, 2015).

The aim of the present research was to find out how to make the acquisition of STEM meaningful for the Millennium generation in the teaching/learning process at school.

The research question: how do students of the Millennium generation perceive STEM learning at school?

Research Methodology

A pilot study by using the questionnaire developed in ERASMUS+ project 'International Diploma for Teacher in Education (eSTEM)' was conducted in December 2017 with the aim to clarify the secondary school students' views on STEM education. The questionnaire was structured in two parts: general and conceptual. The general part characterized student's gender, type of school, and grade, but the conceptual part of the survey identified such issues as curriculum, teaching methods and strategies, students' learning, teaching aids, assessment, school environment and support.

The research involved 256 students from secondary schools and gymnasia of Latvia learning in Grade 10th (n=96), 11th (n=112) and 12th (n=48), of whom 161 were female and 95 male students. The data have been obtained by using of closed-open items using 5-point Likert scale in the online platform of *QuestionPro*. The Cronbach's alpha test was used for internal consistency of the questionnaire. One sample Kolmogorov-Smirnov test helped to test that data follows a normal distribution. As the empirical distribution did not follow to the normal then Spearman's correlation analysis was used to determine the relations of the variables. The Kruskal-Wallis H test was used to determine if there were statistically significant differences between several groups of respondents.

Research Results

The Cronbach's alpha (α = .94) value testifies to the good consistency of the questionnaire items. On the one hand, it testifies about the measuring of the feature with the help of mutually replaceable but content-wise similar questions and, on the other hand, about students' honest attitude to the survey. Figure 1 presents the statistically most significant Spearman correlations (p = 0.01) that comprise three blocks of items. There is a very strong correlation (r = .80) between items about receiving the feedback from classmates and the possibility of self-assessment.

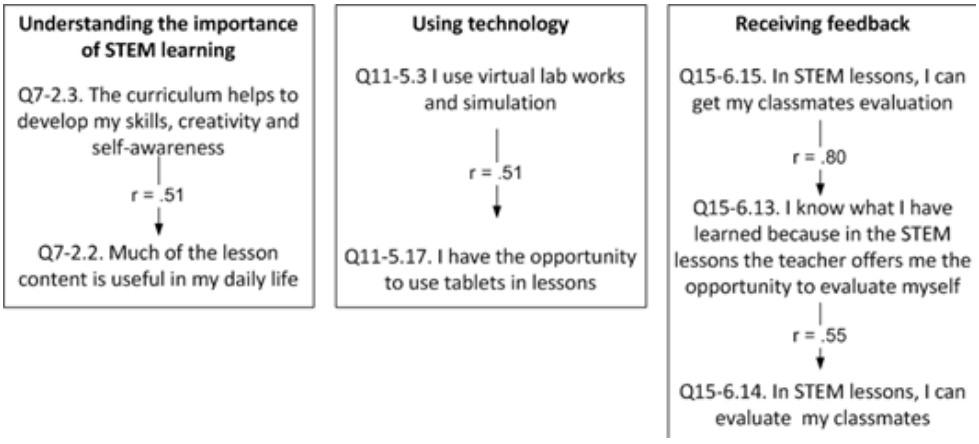

Figure 1. The most characteristic correlations about STEM learning.

The survey proves that, in general, students understand well the role of STEM subjects; they see the connection between the knowledge and skills acquired at school with the daily life and express the willingness to participate actively in the teaching/ learning process at school. However, students perceive differently the STEM learning. The opinions differ considerably on whether learning STEM subjects is difficult. Approximately a quarter of respondents consider that learning is difficult (*agree* and *strongly agree*) (Table 1).

Table 1. Students views of STEM subjects learning difficulties

Item	*M*	*SD*	*Median*	Distribution of answers (%)				
				Strongly disagree (1)	Disagree (2)	Neither agree or disagree (3)	Agree (4)	Strongly agree (5)
Q7-2.4. It is difficult for me to learn STEM	2.87	1.00	3	6.6	31.3	36.3	19.9	5.9

When acquiring STEM subjects, it is important to ensure that they do not seem too difficult for students. Depending on the answers to Q7-2.4 according to Likert's scale students were divided into 5 groups. Applying the Kruskal-Wallis H test, it was identified that there were statistically significant differences to several questions related to the STEM learning among these groups (Table 2). The results showed that learning difficulties are connected with the lack of motivation that result from insufficient appreciation of the teacher's work and failing to see the meaning of learning STEM subjects.

Table 2. Some important differences among students' groups.

Item	*M*	*SD*	*Median*	Chi-Square (χ^2)	*df*	*p*
Q20-3.12. The teacher helps me to develop thinking	3.53	.84	4.00	26.30	4	<.001
Q20-3.13. The teacher encourages me to new ideas	3.26	.90	3.00	18.23	4	.001
Q11-4.5. STEM topics that are acquired at school are not useful for daily life	2.73	1.02	3.00	13.67	4	.008
Q11-4.14. STEM learning attracts my interest and I feel good	3.23	1.00	3.00	17.37	4	.002
Q11-4.15. I am able to use well modern technologies in the learning process	3.77	.96	4.00	12.38	4	.015
Q13-5.12. I participate in the on-line courses MOOCs	1.73	.93	1.00	19.45	4	.001

a. Kruskal-Wallis test
b. Grouping Variable: Q7 - 2.4. It is difficult for me to learn STEM

Although the majority of students assessed highly their skill of using modern technologies, the low mean value of item Q13-5.12 still shows that schools actually do not use the possibility of learning through massive open online courses (MOOCs) that could serve as an excellent resource for supplementing student's knowledge and diversifying the learning methods.

Conclusions and Implications

Certain regularities are observed that characterize students of the Millennium generation and thus highlight some essential indications how to improve a meaningful, real - life connected STEM teaching/learning process.

The student wants to be an active learner, he/she wants to receive an immediate feedback for his/her action both from the teacher and the classmate as well as be the evaluator him/herself – to assess oneself and to evaluate the classmate. The use of technologies is also significant for the student because he/she is certain about his/her digital literacy.

The dramatic differences between the opinions and awareness of different students testify about the complex character of STEM learning, which, in its turn, requires individualized approach in the development of diverse skills.

The study is being continued. It is envisaged to find out in more detail the common and the different features among students who have a different attitude to STEM learning. Teachers are being surveyed along with the students, thus, it will be possible to compare the opinions of two target groups on similar questions. The results of the study could be useful for a better understanding of STEM teaching/learning strategies in Latvia.

References

Howe, N., & Strauss, W. (1997). *The fourth turning: What the cycles of history tell us about America's next rendezvous with destiny*. New York: Broadway.

Howell, L. P., Joad, J. P., Callahan, E., Servis, G., & Bonham, A. C. (2009). Generational forecasting in academic medicine: A unique method of planning for success in the next two decades. *Academic Medicine*, *84*(8), 985-993.

Hunter, C. P. (2013). Shifting themes in OECD country reviews of higher education. *Higher Education, 66*(6), 707-723.

Jain, A. (2015). Don't teach me, let me learn! Millennial learning. *Indore Management Journal, 8*(1), 60-67.

Kirschner, P. A., & De Bruyckere, P. (2017). The myths of the digital native and the multitasker. *Teaching and Teacher Education*, *67*, 135-142.

Lamanauskas, V. (2013). Natural science education importance in adolescence. *Journal of Baltic Science Education*, *12*(4), 396-398.

Sharples, M., de Roock, R., Ferguson, R., Gaved, M., Herodotou, C., Koh, E., & Wong, L. H. (2016). *Innovating pedagogy 2016: Open university innovation report 5*. Milton Keynes: The Open University.

Tapscott, D. (2009). *Grown up digital: How the net generation is changing your world*. New York: McGraw-Hill.

Trifone, J. D. (2006). To what extent can concept mapping motivate students to take a more meaningful approach to learning biology? *Science Education Review*, *5*(4). Retrieved from https://files.eric.ed.gov/fulltext/EJ1057149.pdf.

World Economic Forum (2016). *New vision for education: Fostering social and emotional learning through technology.* Geneva, Switzerland: World Economic Forum. Retrieved 15/04/19, from https://www.weforum.org/agenda/2016/03/21st-century-skills-future-jobs-students.