Learning habits: Does the digital generation have digital stress and how does it affect the learning of mathematics?

Aija Cunska, Vidzeme University of Applied Science (Latvia)
E-mail: aija.cunska@va.lv

PostDoc Latvia
NACIONĀLAIS ATTĪSTĪBAS PLĀNS 2020
EIROPAS SAVIENĪBA
Eiropas Reģionālās attīstības fonds
IEGULDĪJUMS TAVĀ NĀKOTNĒ
23-25 April - Madeira, PORTUGAL InPACT 2022 International Psychological Applications Conference and Trends

INTRODUCTION

Researchers (Jukes, McCain & Crockett, 2010) have emphasized that today's children look the same on the outside as we do, but they are completely different on the inside. Because of digital bombardment, their brains must adapt to all the technologies they spend so much time with. Their brains change physically and chemically. The digital generation has more experience in processing information and data quickly, so they have developed hyperlinked minds. They want enjoyable and active learning, understandable review and immediate feedback. The Covid-19 pandemic hit the education industry worldwide and training could only take place remotely. Researchers (Zhao et al., 2021) have highlighted the benefits of e-learning, but there is still little research on the shadow side of mandatory e-learning driven by Covid-19 and a specific impact on learning mathematics. Therefore, the aim of the study is to determine the initiators of digital stress by using the Stressor-strain-outcome (SSO) framework and the consequences that students face when learning math remotely.

LITERATURE REVIEW

Mathematics is considered by many students to be an unpleasant and incomprehensible subject, which in turn causes anxiety and negatively affects student achievement (Istikomah & Wahyuni, 2018). Researchers Lyons and Beylock (2012) argue that math anxiety has similar symptoms to those experienced by the body for other reasons. Math anxiety is common in students of all ages and is only increasing over the years (Istikomah & Wahyuni, 2018). An additional concern in learning mathematics is the use of technology and has become an important issue in e-learning in recent years (Abdous, 2019). SSO is a popular and well-known theoretical framework that has been developed and applied over time to study the stressors associated with the use of technology (Ayyagari, Grover & Purvis, 2011). SSO usually consists of three components: 1) Stressors, 2) Strain, 3) Outcomes. And researchers (Lee et al., 2021) have highlighted the main "Stressors": Anxiety (A), Social Isolation (SI), Lack of immediate Feedback (LF) and Risks of Self-directed Learning (RSL). As the second section of the SSO or "Strain" in the study, we chose the term digital stress, which researchers (Ragu-Nathan et al, 2008) describe as a phenomenon of stress and the type of psychological stress that users experience in organizations when implementing and using ICT.

TechnoInvasion (TI) is one of the components of digital stress, as the ubiquitous nature of technology interferes with everyday life and learning. Another component of digital stress is **TechnoOverload** (TO), which overloads students and makes them work longer and longer. And the third component is **TechnoExhaustion** (TE), which is characterized by feelings of fatigue and the inability to cope with new ICTs in a healthy way during compulsory e-learning (Lee at al., 2021).

We selected **Learning Satisfaction** (LS) and **Learning Performance** (LP) as components of the third SSO or "Outcomes" section, which are often used as key indicators to assess the effectiveness of the learning environment (Xu et al., 2014). Researchers (Lee et al., 2021) emphasize that digital stress can contribute to poor learning outcomes and performance, and that the component of student satisfaction is a crucial predictor of learning achievement.

RESEARCH METHODOLOGY

As part of the study, an electronic survey was conducted for students of different schools, ages and genders in Latvia in April, May and November 2021, when Latvian schools were closed due to the Covid-19 pandemic and education could only take place online. A total of 185 responses were received. The survey was coordinated with the Vidzeme University of Applied Science Academic Ethics Commission and questions was rated on a Likert five-point scale (from "1 - strongly disagree" to "5 - strongly agree").

When studying students' behaviour during distance learning mathematics, a graphical representation of the theoretical model was created (Figure 1) and the following seven hypotheses were put forward:

H1: Anxiety contributes to digital stress;
H2: Social isolation contributes to digital stress;
H3: Lack of feedback has a positive effect on the occurrence of digital stress;
H4: Risks of self-directed learning have a positive effect on the development of digital stress;
H5: Digital stress has a negative effect on learning satisfaction;
H6: Digital stress negatively affects learning performance;
H7: Learning satisfaction has a positive effect on learning performance.

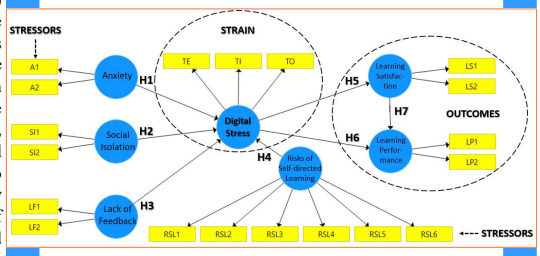

Figure 1. *Graphical representation of the theoretical model of the research*

Due to the presence of the second order structure "Digital Stress", the collected data were analyzed using the Partial Least Squares Structural Equation Modelling (PLS-SEM) method and SmartPLS application, which is able to analyze more complex higher order structures (Lee et al., 2021).

DATA ANALYSIS

To evaluate the hypotheses, we have summarized in a Table 1 the Cronbach's Alpha, Rho_A, and Composite Reliability values above the 0.70 threshold and all Average Variance Extracted (AVE) values are greater than 0.50, so the reliability and validity convergence are considered stable (Lee et al., 2021).

In Table 1 we summarized and showed that the quality of the second-order construct "Digital Stress" is adequate because 1) all associated first-order structures have a significant Outer Weights (0.453, 0.576, 0.287) and 2) Variance Inflation Factors (2,717, 2,341, 2,459) are below the five-point threshold (Lee et al, 2021).

Table 1 is also summarized the testing results of structural model using the SmartPLS program capabilities.

Six hypotheses (H1, H3, H4, H5, H6, and H7) are fully supported because the absolute values of Path Coefficients are> 0.1 and P-values are <0.001. In turn, one hypothesis (H2) is partially supported because the Path Coefficient value is slightly less than 0.1 and the P-value is slightly greater than 0.001.

Table 1.

Reliability and convergent validity,

	Cronbach's Alpha	Rho_A	Composite Reliability	AVE
Anxiety	0.876	0.893	0.941	0.889
Digital Stress	0.723	0.806	0.829	0.622
Lack of Feedback	0.881	0.882	0.944	0.894
Learning Performance	0.752	0.753	0.890	0.801
Learning Satisfaction	0.723	0.749	0.877	0.781
Risks of Self-directed Learning	0.840	0.916	0.878	0.570
Social Isolation	0.716	0.732	0.875	0.777

Quality of the second-order construct,

Second-Order Construct	First-Order Constructs	Outer Weights	Variance Inflation Factors
Digital Stress	Techno-Exhaustion	0.453	2.717
	Techno-Invasion	0.576	2.341
	Techno-Overload	0.287	2.459

Hypotheses testing results.

Hypotheses and Paths	Path Coefficients	P-values	Supported?
H1: Anxiety → Digital Stress	0.238	0.0000	Yes
H2: Social Isolation → Digital Stress	0.099	0.0711	Partially
H3: Lack of Feedback → Digital Stress	0.996	0.0000	Yes
H4: Risks of Self-Directed Learning → Digital Stress	0.325	0.0001	Yes
H5: Digital Stress → Learning Satisfaction	-0.187	0.0008	Yes
H6: Digital Stress → Learning Performance	-0.314	0.0000	Yes
H7: Learning Satisfaction → Learning Performance	0.619	0.0000	Yes

CONCLUSIONS

The results confirm previous studies (Lee et al, 2021) and fully support six (H1, H3, H4, H5, H6, H7) hypotheses that suggest that the digital generation is under digital stress, which in turn has a negative impact on math learning.

The partially supported hypothesis H2 suggests that there is an insignificant association between social isolation and digital stress, as students today are not isolated and can easily communicate and maintain social bonds with each other through social media (Lee et al., 2021).

The study helped to delve into students 'feelings and needs, as well as to develop recommendations to further mitigate the effects of the pandemic, to manage learning processes more effectively, to gain students' respect and to promote better math learning.

Educators are encouraged to develop plans that can reduce the impact of stressors (anxiety, lack of feedback, risks of self-directed learning) on digital stress and math learning in general.

In order to avoid additional stress, we recommend:

1) to explain more to students the use of ICT tools,
2) to introduce continuous, immediate and innovative feedback methods, also using emotion analysis,
3) to include new strategies and methods in the learning process that would allow catch moments of loss understanding of mathematics topics and which would keep students' interest and motivation,
4) to develop support systems that help and teach students to plan time and resources for e-learning,
5) schools to take care of teachers' digital skills training and support systems.

ACKNOWLEDGMENTS

AI4Math

The research is carried out within the framework of the postdoctoral project "Artificial Intelligence (AI) Support for Approach of Accelerated Learning of Mathematics (AI4Math) (1.1.1.2/VIAA/3/19/564)" at Vidzeme University of Applied Sciences with the support of ERAF.

REFERENCES

Abdous, M. (2019). Influence of satisfaction and preparedness on online students' feelings of anxiety. *The Internet and Higher Education*, *41*, 34–44.

Ayyagari, R., Grover, V., Purvis, R. (2011). Technostress: Technological antecedents and implications. *MIS Quarterly, 35* (4), 831–858.

Istikomah, E., Wahyuni, A. (2018). Student's Mathematics Anxiety on the Use of Technology in Mathematics Learning. *Journal of Research and Advances in Mathematics Education, 3* (2), 69-77.

Jukes, I., McCain, T., Crockett, L. (2010). Understanding the Digital Generation. Teaching and Learning in the New Digital Landscape. *21st Century Fluency Project Inc.*

Lee, V-H., Hew, J-J., Leong, L-Y., Tan, G.W-H., Ooi, K-B. (2021). The Dark Side of Compulsory e-education: Are Students Really Happy and Learning during the COVID-19 Pandemic? *International Journal of Human–Computer Interaction.*

Lyons, I.M, Beilock, S.L. (2012). When Math Hurts: Math Anxiety Predicts Pain Network Activation in Anticipation of Doing Math. *PlosOne. 7* (10), 1-6.

Ragu-Nathan, T.S., Tarafdar, M., Ragu-Nathan, B.S., Tu, Q. (2008). The consequences of technostress for end users in organizations: conceptual development and empirical validation. *Inform. Syst. Res. 19*, 417–433.

Xu, D., Huang, W.W., Wang, H., Heales, J. (2014). Enhancing e-learning effectiveness using an intelligent agent-supported personalized virtual learning environment: *An empirical investigation. Information and Management, 51* (4), 430–440.

Zhao, Y., Wang, N., Li, Y., Zhou, R., Li, S. (2021). Do cultural differences affect users' e-learning adoption? A meta-analysis. *British Journal of Educational Technology, 52* (1), 20–41.