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Psychological Aspects of Digital Learning: A Self-Determination Theory Perspective

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Abstract

The purpose of this article was to compile a general map of existing research on digital education from the Self-determination theory (SDT) perspective, in order to understand SDT's contribution to the emerging field of research on digital technologies in education, the methods used to advance this research, the gaps in existing research, and the development of the theory itself in this context. Methods include searching in databases or search engines and chaining from known research papers. Papers were classed as relevant if their primary focus was to explore the Self-determination theory perspective for digital education. Articles published over the past twelve years in leading scientific journals were analyzed and synthesized. Results show that this theory is actively used both in studies on digital education and in the development of training programs. It makes a significant contribution to solving the problem of continuing digital learning and its motivation, to predicting the academic success of students, to increasing teachers' motivation to use digital resources. The ideas of SDT have become an important reference point in various formats of digital education: MOOC, hybrid virtual classes, mobile applications, etc. The study found that digital education technologies provide many opportunities to satisfy the need for autonomy whereas they pose the greatest challenge to the need for relatedness. Research in the context of digital education provides new perspectives for the development of SDT, clarifying the relationships of basic needs among themselves. The materials presented in the article are useful for planning further research from the point of view of SDT, as well as for use in the development of digital educational resources. The scientific novelty of this study is to collate, highlight and generalize the directions of application of Self-determination theory in the rapidly developing field of digital education. As an original result, a new general map of the main areas of such research has been created. The review categorizes the literature into five different areas: predicting motivation and intentions to continue digital learning, predicting student academic success, combining SDT ideas with other theories in digital education research, application of SDT for creating online courses, and teachers' readiness to use digital education.

Keywords: self-determination theory, internal motivation, online learning, digital education

INTRODUCTION

Relevance of the Subject

Currently, the education system is rapidly mastering digital technology. This includes a wide variety of tools that can increase the accessibility of education, expand its audience, and qualitatively develop teaching methods. Among such tools are mobile technologies, massive open online courses (MOOC), synchronous and asynchronous online courses, hybrid on-line and off-line training, hybrid virtual classes for connecting local and remote students, and much more (Bubnova et al., 2018; Razumovskaya et al., 2018). The interest in how people interact and develop in these complex and diverse spaces is steadily growing, as recorded in one of the first systematic reviews of MOOC research, from 2008 – 2012 (Liyanagunawardena, Adams, & Williams, 2013). New questions continue to arise.

First of all is the question of the effectiveness of digital education. Some problems that may interfere with quality learning are indicated. Initial studies showed that although there is no significant difference in grades between online and traditional classroom contexts, students in online courses were significantly less satisfied in several ways than students in the traditional classroom. This raised the question of the specifics of the different aspects of online learning and the factors that act there (Summers, Waigandt, & Whittaker, 2005). Analyzing publications on the issue of self-regulatory learning strategies in the online environment over 10 years, Broadbent and Poon (2015) highlighted a series of correlates of academic achievement in online higher education. On the one hand, they largely coincided with factors that influence academic success in the traditional system, but on the other hand, were weaker in their power. The authors suggested that other, yet unexplored factors may be more important in online contexts.

The most frequently mentioned and pressing issue with online courses is the high dropout rate (Chen & Jang, 2010). The MOOC completion rate for most courses is very low (Sun et al., 2019), and this shows that learning barriers are a serious problem (Kennedy, 2014). In a review of studies on the main motives and problems of using MOOC, Hew and Cheung (2014) found that up to 90% drop out due to lack of incentives, misunderstanding of the content of materials and lack of necessary assistance.

Important issues are related to the adoption and application of the educational information system. A comparison of two different MOOC models (connectivism and the traditional pedagogical approach) showed that they use different approaches and teaching methods, and therefore attract different audiences (Kennedy, 2014). Accordingly, the problems of these models also differ. The first (c-MOOC) means a social, distributed, networked approach and implies significant student autonomy. It raises questions about the levels of learner autonomy, presence, and critical literacies required in active connectivist learning (Kop, 2011). Observing the growing tensions between the elements of connectivity that are thought to be necessary for effective learning (Tschofen & Mackness, 2012), the authors believe that students may vary greatly in their desire for and interpretation of connectivity, autonomy, openness, and diversity.

Regarding the new realities of digital education, a number of new theories are emerging. Some provisions of these concepts follow in part the views of SDT. For example, key teaching principles in connectivism include autonomy and connectedness (Tschofen & Mackness, 2012), ideas which are central to SDT (Ryan & Deci, 2017). Indeed, very often researchers turn to motivation issues, since it is known that the online learning environment requires a higher level of self-regulation, for which the quality and level of motivation are crucial (de Barba, Kennedy & Ainley, 2016; Buhr, Daniels & Goegan, 2019). Moreover, with respect to course completion, the role of internal motivation, in particular, has been emphasized (Barak, Watted & Haick, 2016). All this has led to the active use of self-determination theory (SDT) in the study of digital education (Ryan & Deci, 2017).

Fundamentals of SDT and its Application in Education

Self-determination theory (SDT) is a theory of motivation that suggests that what is important is not simply the amount of motivation, but the quality of motivation a person has for activity in a specific domain (Ryan & Deci, 2017). The theory distinguishes between external motivation (engaging in an activity to earn a reward

or avoid a punishment) and internal motivation (engaging in an activity because it is personally important, valued, enjoyable, or interesting) and suggests that motivation can be thought of as existing along a continuum, from external to internal. Compared to external motivation, internal motivation is associated with better outcomes. SDT has been used extensively in the context of traditional education (Larionova et al., 2018). Numerous studies have demonstrated that both intrinsic motivation and the more self-determined (i.e., autonomous) types of extrinsic motivation contribute to both engagement and optimal learning in different educational contexts (Niemiec & Ryan, 2009). Satisfying basic psychological needs stimulates a deep approach to learning and reduces avoidance strategies, all of which leads to an increase in academic achievement (Betoret & Artiga, 2011).

The purpose of the present article was to draw up a general picture of the research on digital education in terms of self-determination theory, firstly, to highlight the main directions of that theory's contribution to the development of digital technologies, and secondly, to understand how the theory itself is developing in the context of digital education research.

METHODS

Data Collection

Methods to identify articles for inclusion in the literature review included searching in databases or search engines and chaining from known research papers (Ellis & Haugan, 1997). The purpose of this was study was to locate and analyze SDT related academic literature to compile a general map of existing research on digital education from the Self-determination theory (SDT) perspective. This is necessary, first, in order to understand SDT's contribution to the emerging field of research on digital technologies in education, methods applied in research, and gaps in the existing literature, and second, in order to understand the development of the theory itself in this context.

We identified the relevant documents as a result of a series of searches based on publications included in the Scopus academic database. Documents were classified as relevant if their main task was to study digital education in the context of Self-determination theory (SDT). Articles were selected from these databases based on the article's title and keywords. Specifically, key concepts and terminology deriving from self-determination theory and from the context of digital education were utilized as selection criteria.

Initially, search queries were selected that aimed to identify research in the context of the theory of self-determination: self-determination, internal motivation, basic psychological needs. The following queries were used to identify the context of digital education: e-learning, online learning, digital education. Results of these two searches were combined.

In order to improve the coverage of the relevant publications that will be included in this review, the chaining method was used (Gao, Luo, & Zhang 2012). This method involves looking at references cited in the publications yielded by our search, in order to find other relevant work. This led to the inclusion of additional articles. At the same time, we excluded from consideration publications in conference proceedings in which only a research plan was proposed and its results had not yet been obtained.

The data collection process resulted in the identification of 47 distinct articles – 44 from journals and 3 conference publications. All articles were published over the past twelve years in leading scientific journals indexed in the Scopus and Web of Science databases.

Data Analysis

Articles were qualitatively classified using open coded content analysis (Gao, Luo, & Zhang 2012). Initially, the third author searched for key terms, collected a database of publications and proposed an initial classification of the main topics of all these publications. Then the first author read each of the articles in order to independently identify topics, highlight the main areas of research and create a classification of

these areas. This classification was discussed and refined by all authors who considered different alternative classifications. Based on a detailed discussion, the authors created the final classification of the studies.

Particular attention in the analysis was given to the research methods that were used, whether they were qualitative or quantitative. In general, among the studies identified there was a preference for quantitative methods, in which data collection was carried out using surveys and various automated tools. Only four studies were based on qualitative methods (interviews, observations, focus groups, etc.).

RESULTS

SDT in Predicting Motivation and Intentions to Continue Digital Learning

More than 10 years ago, when the big dropout problem became apparent, Roca and Gagné (2008) suggested that applying SDT to e-learning could be useful in predicting intentions to continue learning in the workplace. Since there may be differences in the role of basic need satisfaction in the motivation for online and offline learning (Wang et al., 2019), it is impossible to simply transfer the available data to the new conditions of digital education.

Recent studies show that meeting the three basic psychological needs for autonomy, competence and relatedness has a significant positive effect on intrinsic motivation, increasing students' psychological engagement in Massive Open Online Classes, or MOOCs (Sun et al., 2019). Moreover, according to other sources (Fang et al., 2019), need satisfaction completely mediates the impact of social interaction on academic engagement in a MOOC. However, the opposite results have also been obtained. Thus, in deciding what affects the continued use of C-MOOC, among others, self-determination factors were investigated and they unexpectedly did not have a significant effect on satisfaction with the course itself, although they did significantly affect the students' intention to continue using the course. Only ease of use and usefulness had a positive impact on satisfaction (Joo, So, & Kim, 2018).

In addition to its application in studies on MOOC, SDT has also been used to study the use of mobile training applications (Jeno et al., 2019; Yang, Zhou, & Cheng, 2019). Here the main results indicate the influence of self-determination factors (e.g., basic need satisfaction; internal versus external motivation) on engagement and the intention to continue learning in the mobile mode. In addition, it is noted that the format of mobile learning itself contributes to meeting the need for autonomy, and this in turn determines academic achievements and the successful assimilation of educational material (Jeno et al., 2019).

Basic Psychological Needs in the Context of Digital Education: Predicting Student Academic Success

A number of studies have raised the issue of the impact of SDT variables on learning outcomes. Conflicting data have been obtained on this issue. According to results obtained by Chen and Jang (2010), the SDT-based model does not predict learning outcomes in online programs. Having critically analyzed the methods used by Chen and Jang (2010), and Hsu, Wang, and Levesque-Bristol (2019) modified the measurement methods and conducted a study based on the SDT model. Their results showed that the satisfaction of basic psychological needs strengthened self-regulatory motivation, and this was associated with higher success in mastering knowledge and achieving learning goals in online courses.

It turns out that satisfaction of different basic psychological needs has different effects on different parameters of online learning. Although satisfying the need for competence was the strongest predictor of engagement when learning through MOOC, satisfying the need for autonomy was the weakest (Fang et al., 2019). In another study, probabilistic relationships were established between the basic psychological needs of learners in the context of one MOOC: participants with high autonomy had an 80.01% probability of experiencing an average level of competence, while relatedness was separate from both autonomy and competence (Durksen et al., 2016).

A positive impact of a mobile application on intrinsic motivation, perceived competence and student achievement has been found. Students using ArtsApp, an application designed for use by biology students,

had higher intrinsic motivation, perceived competence, and achievement compared to the control group that used a traditional textbook. Intrinsic motivation, in turn, predicted higher achievement in terms of grades, higher interest in the content of the course, and higher appreciation of the importance of the knowledge gained. The best results were associated with satisfaction of students' psychological needs for autonomy, competence, and relatedness. Contributing factors included interest, choice, and feedback, which were built-in functions in the mobile application (Jeno, Grytnes, & Vandvik, 2017).

At one's own discretion, one can choose to use mobile education technologies at any time and anywhere (Hamidi & Chavoshi, 2018) and this fact promotes autonomy. A completely different situation may arise in connection with the satisfaction of another basic psychological need, the need for relatedness. The need for belonging is a powerful, fundamental and extremely widespread motivation; it has multiple and strong influencec on emotional and cognitive processes (Baumeister & Leary, 1995). In the context of SDT, it occupies an important place. Massive Open Online Courses (MOOCs) create a new educational environment where the need for relatedness can play a particularly important role. MOOCs, scientists say, provide unprecedented opportunities for both relatedness and isolation. Research (Durksen et al., 2016) confirms that relatedness can indeed be an important need in this context. Thus, students noted that in the context of online courses it is more difficult to organize group work, and this means that meeting this need can be more difficult, especially for those who ordinarily like to work in groups (Vanslambrouck et al., 2018; Zaitseva et al., 2020). Other authors also write that online courses often limit the development of relatedness, which is critical to success in any learning environment (Butakova et al., 2020; Butz & Stupnisky, 2017; Raes et al., 2020). This becomes not only another aspect of the analysis of digital technologies in education, but it can be a challenge to them, as Deci and Ryan (2014) argued that not all relationships are of high quality and satisfy the need for relatedness. Are such high-quality relationships possible in the context of digital education technologies?

Researchers are looking for answers to this question. For example, one study showed the importance of organizing and participating in forums to maintain the need for relatedness (Butz & Stupnisky, 2017). Here, the forum is seen as a means of developing relationships between people who attend online courses. This means that basic needs can be satisfied by the structure of the organization of the online course itself. There are other possibilities, for example, the participation of mentors. By exploring the role of a mentor in meeting students' need for relatedness in online courses, Baranik, Wright, and Reburn (2017) suggested that mentoring helps students succeed in online activities by satisfying basic psychological needs.

SDT for Creating Courses

Some of the fundamental ideas of SDT are used not only for research, but also in the development of digital educational resources.

Martin, Kelly, and Terry (2018) proposed a framework for developing MOOCs based on SDT principles. This structure establishes the connection between intrinsic motivation and the basic psychological needs for autonomy, competence and relatedness. The authors have already received preliminary evidence that the SDT-based design structure is useful in developing MOOCs and can successfully attract students by increasing engagement, completion, and intrinsic motivation.

SDT was used to develop a digital design project for beginner students in order to increase internal motivation to continue their studies in engineering and digital design (Danowitz, 2016). It has been used to improve the digital librarianship program in Australia: analyzing the program through the lens of SDT made it possible to critically evaluate it at a deeper level (Robertson, 2018). The ideas behind SDT formed the basis for the development of a template with a web extension for the design of courses and study strategies regardless of the discipline taught (Bachman & Stewart, 2011).

SDT, combined with cognitive load theory, has become the conceptual basis for developing an online emergency medicine course based on Moodle (De Araujo Guerra Grangeia, et al., 2016).

SDT was used both in the strategy of motivational gamification (Proulx et al., 2017; Shi & Cristea, 2016; Tan, 2018), and to build a reward system for children in the gamification of physical training (Ahn, Johnsen, & Ball 2019). It helps to understand the mechanism by which different types of feedback can lead to the enjoyment of a video game, which is important for improving these games. If the feedback, rules, and social elements of games correspond to SDT parameters (autonomy, competence, and relatedness), one can predict enjoyment of the game (Rogers, 2017).

Combining SDT Ideas with Other Theories in Digital Education Research

Ideas from SDT have been used in interesting and productive ways in combination with other theories, and often the action of certain factors mediates the influence of others.

Thus, Faye and Sharpe (2008) investigated the importance of basic psychological needs for academic motivation and learned, based on path analysis, that identity and closeness predicted academic motivation, and these relationships were mediated by basic psychological needs.

A number of studies have used a combination of SDT and other models to predict the success of various aspects of using MOOC. Interesting results have been obtained on the interrelationships among basic psychological needs, cognitive assessments, and the emotions of boredom and pleasure in a MOOC (Buhr, Daniels, & Goegan, 2019).

A simultaneous study of social interaction and satisfaction of psychological needs (Fang et al., 2019) found that the identification of a mutual learning group enhanced the impact of social interaction on meeting psychological needs. At the same time, the satisfaction of psychological needs mediated the relationship between social interaction and involvement in learning.

In a study of the factors affecting students' acceptance of MOOC, the authors, in line with SDT, included social motivation and matching of tasks and technologies in the model. It turned out that perceived competence and perceived relatedness had a positive and significant impact on students' behavioral intentions regarding MOOC adoption (Khan et al., 2018).

In combination with the Unified Theory of Acceptance and Use of Technology, a relationship was obtained between user motivation (assessed in terms of SDT) and technology adoption (Pedrotti & Nistor, 2016).

Based on SDT, combined with variables such as perceived ICT competence and institutional innovation orientation, Cincinnato, Zhu and De Wever (2016) designed a study of factors that influence teaching methods in the context of online and blended learning (OBL).

In studying the factors that influence students' decisions to use MOOC, Zhou (2016) relied on the theory of planned behavior (TPB) and self-determination theory (SDT). It turned out that autonomous motivation preceded all three of the main TPB constructs.

SDT was used to study the effect of motivation type on the performance of Open Source Software (OSS) development tasks. The authors (Ke & Zhang, 2010) integrated SDT with an affective event theory and studied how satisfying competence, autonomy, and relatedness needs weakened the relationship between external motivation and tasks.

SDT in Digital Education: A Teacher's View

Digital education is a challenge not only for those who study, students, but also for those who teach, teachers. Sørebø et al. (2009) found that taking basic psychological needs and intrinsic motivation into account is useful in predicting teachers' intentions to continue using e-learning in their work with students.

The associations among basic psychological needs, levels of engagement, emotions and emotional exhaustion associated with learning were studied. For teachers, meeting the need for relatedness with students led to higher levels of engagement and positive emotions and lower levels of negative emotions than satisfying the need for relatedness with colleagues (Klassen, Perry, & Frenzel, 2012).

Perceived autonomy and competence had a positive effect on the internal motivation and willingness of school teachers to adopt and reuse e-learning (Chang, Fu, & Huang, 2017).

The intrinsic motivation of teachers in the context of cloud computing technology and cloud virtual learning environment (VLE) was investigated. Here, training resources can be accessed, stored, retrieved, and shared in the cloud anytime, anywhere without any restrictions. SDT factors significantly influenced the intention to use VLE (Hew & Kadir, 2016).

Teachers' intentions to use or not to use digital learning materials (DLM) were assessed based on the integration of SDT and the theory of planned behaviour/integrated model of behaviour prediction (IMBP) (Kreijns et al., 2014). The unified model potentially provided a more comprehensive explanation of teachers' volitional behavior regarding the use of DLMs.

DISCUSSION

As the results of this review found, studies conducted from the standpoint of self-determination theory on the specifics of digital education in different cultures have been extremely rare. In one study of factors affecting students' acceptance of massive open online courses (MOOC), the authors wrote that their findings applied to a developing country (Khan et al., 2018), but there was no comparison with other cultures. Similar studies in Russia, where online training is at the initial stages of implementation, have not been conducted. We think such studies are relevant for the construction and development of the digital education system in Russia.

As can be seen, in addition to students, SDT was useful for explaining the effectiveness and for improving the online learning process for employees (Belkhamza & Bin Abdullah, 2019). However, specific inquiries regarding digital education among different groups, by age and profession, from the point of view of self-determination theory are also represented by isolated studies.

Specificity of Research Methods

In an analysis of the flow of empirical studies of MOOC from 2013 – 2015, Veletsianos and Shepherdson (2016) wrote that preference was given to a quantitative, if not positivistic, approach to research (data collection using surveys and automated methods). Only a few studies were based on qualitative methods (interviews, observations, and focus groups). Our review also showed that quantitative methods prevail in the literature, although there are examples of using qualitatively oriented methods, such as semi-structured individual interviews for analyzing motivation based on SDT (Escobar Fandiño, Muñoz, & Silva Velandia, 2019).

It is qualitative methods that show the specifics of different age groups in relation to digital education and allow us to find out the components that should be paid attention to in interactive and blended education (OBL) for adults, especially when trying to satisfy basic psychological needs. Thus, in an interview, adult students indicated that they highly appreciated moments of contact and this helped them to learn more and better. However, sometimes they preferred aspects of distance learning, as it allowed them to study independently, continuing whatever task they are currently engaged in. They noted difficulties of working in groups (Vanslambrouck et al., 2016). A qualitative analysis of student project blog evaluations showed that they perceived scientific writing on the internet as an internally motivating educational task, recognized and valued their autonomy, and considered a sense of competence and interconnectedness with other people in joint work to be positive (Kramer & Kusurkar, 2017). Students' voices about the motivation to join a MOOC, the perception of success and the obstacles that arise when trying to complete their studies were heard in interviews with 12 adult students through the lens of self-directed learning theories and SDT (Loizzo et al., 2017).

CONCLUSION

Self-determination theory is actively being used in the study of digital learning, in recent years many articles have appeared, and interesting data have been obtained. Among the areas of research, the following can be

identified: predicting intentions to continue in digital learning, motivation for learning, predicting academic success of students, motivation to use digital resources on the part of teachers. SDT provides an important basis for creating digital resources and building a system of interaction with students in various formats of digital education (MOOC, hybrid virtual classes, mobile applications, etc.).

Meeting basic needs has proven to be the most important issue in addressing the motivation for continuing in a course. Digital education maximally meets the need for autonomy: the person can determine for oneself when, in what mode, and how to learn. In contrast, online learning presents the greatest challenge to the need for relatedness, because the learning paths and organizational learning conditions are as individualized as possible. This is especially true for asynchronous online courses, as opposed to synchronous ones, in which there is the potential for real-time interaction between students and the teacher. The need for competence is most independent of on-line or off-line training, as it is set by the methods of constructing training material, task sequences by level of complexity, and feedback quality. The data obtained in the studies of on-line training also give grounds to take a fresh look at the relationships among the basic needs: because the need for competence turned out to be dependent on inclusion in the community, its maintenance requires recognition of success not only by the teacher or the person himself, but also by the community.

It is possible to talk about the mutual influence of meeting basic needs on student success when using digital education and about digital education as a powerful tool to meet these needs in the learning process.

The challenge remains to expand research for different populations and in different cultures, although some comparative studies have already been conducted.

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REFERENCES

Ahn, S. J., Johnsen, K., & Ball, C. (2019). Points-Based Reward Systems in Gamification Impact Children's Physical Activity Strategies and Psychological Needs. *Health Education and Behavior*, *46*(3), 417-425. https://doi.org/10.1177/1090198118818241

Bachman, C. M., & Stewart, C. (2011). Self-Determination Theory and Web-Enhanced Course Template Development. *Teaching of Psychology*, *38*(3), 180-188. https://doi.org/10.1177/0098628311411798

Barak, M., Watted, A., & Haick, H. (2016). Motivation to learn in massive open online courses: Examining aspects of language and social engagement. *Computers and Education*, *94*, 49-60. https://doi.org/10.1016/j.compedu.2015.11.010

Baranik, L. E., Wright, N. A., & Reburn, K. L. (2017). Mentoring relationships in online classes. *Internet and Higher Education*, *34*, 65-71. https://doi.org/10.1016/j.iheduc.2017.05.001

Baumeister, R. F., & Leary, M. R. (1995). The Need to Belong: Desire for Interpersonal Attachments as a Fundamental Human Motivation. *Psychological Bulletin*, *117*(3), 497-529. https://doi.org/10.1037/0033-2909.117.3.497

Belkhamza, Z., & Bin Abdullah, M. M. (2019). Trainee characteristics and organizational environment for enhancing individual performance in e-learning involvement. *International Journal of Web-Based Learning and Teaching Technologies*, *14*(2), 88-101. https://doi.org/10.4018/IJWLTT.2019040106

Betoret, F. D., & Artiga, A. G. (2011). The relationship among student basic need satisfaction, approaches to learning, reporting of avoidance strategies and achievement. *Electronic Journal of Research in Educational Psychology*, *9*(2), 463-496.

Broadbent, J., & Poon, W. L. (2015). Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review. *Internet and Higher Education*, *27*(573) 1-13. https://doi.org/10.1016/j.iheduc.2015.04.007

Bubnova, I. S., Khvatova, M. A., Chernik, V. E., Popova, O. V., Prokopyev, A. I., Naumov, P. Yu., & Babarykin, O. V. (2018). Research of Professional Activity Features of Ecologist at Carrying Out Public Ecological Examination. *Ekoloji, 106*, 999-1006, Article No: e106183

Buhr, E. E., Daniels, L. M., & Goegan, L. D. (2019). Cognitive appraisals mediate relationships between two basic psychological needs and emotions in a massive open online course. *Computers in Human Behavior*, *96*, 85-94. https://doi.org/10.1016/j.chb.2019.02.009

Butakova, M. M., Sokolova, O. N., Zaitseva, N. A., Larionova, A. A., Ignatova, M. N., Trufanova, S. N., & Yakovlev, A. Y. (2020). Evolution and current development trends of the Russian federation's higher education system. *Opción, 36*(Special Edition 27), 1718-1733.

Butz, N. T., & Stupnisky, R. H. (2017). Improving student relatedness through an online discussion intervention: The application of self-determination theory in synchronous hybrid programs. *Computers and Education, 114*, 117-138. https://doi.org/10.1016/j.compedu.2017.06.006

Chang, H. H., Fu, C. S., & Huang, C. Y. (2017). Willingness to adopt or reuse an e-learning system: The perspectives of self-determination and perceived characteristics of innovation. *Innovations in Education and Teaching International*, *54*(5), 511-520. https://doi.org/10.1080/14703297.2016.1194768

Chen, K. C., & Jang, S. J. (2010). Motivation in online learning: Testing a model of self-determination theory. *Computers in Human Behavior*, *26*, 741-752. https://doi.org/10.1016/j.chb.2010.01.011

Cincinnato, S., Zhu, C., & De Wever, B. (2016). Teacher and institutional characteristics affecting teaching practices in OBL: A self-determination approach. *Proceedings of the European Conference on e-Learning*, pp. 750-757.

Danowitz, A. (2016). Leveraging the final project to improve student motivation in introductory digital design courses. *Proceedings* - 46th Annual *Frontiers in Education Conference, FIE 2016*, Bayfront Convention CenterErie; United States, 7757380. https://doi.org/10.1109/FIE.2016.7757380

De Araujo Guerra Grangeia, T., De Jorge, B., Franci, D., Santos, T. M., Setubal, M. S. V., Schweller, M., & De Carvalho-Filho, M. A. (2016). Cognitive load and self-determination theories applied to e-learning: Impact on students' participation and academic performance. *PLoS ONE*, *11*(3), e0152462. https://doi.org/10.1371/journal.pone.0152462

De Barba, P. G., Kennedy, G. E., & Ainley, M. D. (2016). The role of students' motivation and participation in predicting performance in a MOOC. *Journal of Computer Assisted Learning*, *32*(3), 218-231. https://doi.org/10.1111/jcal.12130

Deci, E. L., & Ryan, R. M. (2014). Autonomy and need satisfaction in close relationships: Relationships motivation theory. *Human Motivation and Interpersonal Relationships: Theory, Research, and Applications*, V.9789401785426, 53-73. https://doi.org/10.1007/978-94-017-8542-6_3

Durksen, T. L, Chu, M. W., Ahmad, Z. F., Radil, A. I., & Daniels, L. M. (2016). Motivation in a MOOC: a probabilistic analysis of online learners' basic psychological needs. *Social Psychology of Education*, *19*(2), 241-260. https://doi.org/10.1007/s11218-015-9331-9

Ellis, D., & Haugan, M. (1997). Modelling the information seeking patterns of engineers and research scientists in an industrial environment. *Journal of Documentation, 53*, 384-403. https://doi.org/10.1108/EUM0000000007204

Escobar Fandiño, F. G., Muñoz, L. D., & Silva Velandia, A. J. (2019). Motivation and E-Learning English as a foreign language: A qualitative study. *Heliyon*, *5*(9), e02394. https://doi.org/10.1016/j.heliyon.2019.e02394

Fang, J., Tang, L., Yang, J., & Peng, M. (2019). Social interaction in MOOCs: The mediating effects of immersive experience and psychological needs satisfaction. *Telematics and Informatics*, *39*, 75-91.

Faye, C., & Sharpe, D. (2008). Academic motivation in university: The role of basic psychological needs and identity formation. *Canadian Journal of Behavioural Science*, *40*(4), 189-199. https://doi.org/10.1037/a0012858

Gao, F., Luo, T., & Zhang, K. (2012). Tweeting for learning: A critical analysis of research on microblogging in education published in 2008-2011. *British Journal of Educational Technology*, *43*(5), 783-801. https://doi.org/10.1111/j.1467-8535.2012.01357.x

Hamidi, H., & Chavoshi, A. (2018). Analysis of the essential factors for the adoption of mobile learning in higher education: A case study of students of the University of Technology. *Telematics and Informatics*, *35*(4), 1053-1070. https://doi.org/10.1016/j.tele.2017.09.016

Hew, K. F., & Cheung, W. S. (2014). Students' and instructors' use of massive open online courses (MOOCs): Motivations and challenges. *Educational Research Review*, *12*, 45-58. https://doi.org/10.1016/j.edurev.2014.05.001

Hew, T. S., & Kadir, S. L. (2016). Predicting the acceptance of cloud-based virtual learning environment: The roles of Self Determination and Channel Expansion Theory. *Telematics and Informatics*, *33*(4), 990-1013. https://doi.org/10.1016/j.tele.2016.01.004

Hsu, H. K., Wang, C. V., & Levesque-Bristol, C. (2019). Reexamining the impact of self-determination theory on learning outcomes in the online learning environment. *Education and Information Technologies*, *24*(3), 2159-2174. https://doi.org/10.1007/s10639-019-09863-w

Jeno, L. M., Grytnes, J. A., & Vandvik, V. (2017). The effect of a mobile-application tool on biology students' motivation and achievement in species identification: A Self-Determination Theory perspective. *Computers and Education*, *107*, 1-12. https://doi.org/10.1016/j.compedu.2016.12.011

Jeno, L. M., Vandvik, V., Eliassen, S., & Grytnes, J. A. (2019). Testing the novelty effect of an m-learning tool on internalization and achievement: A Self-Determination Theory approach. *Computers and Education, 128*, 398-413. https://doi.org/10.1016/j.compedu.2018.10.008

Joo, Y. J., So, H. J., & Kim, N. H. (2018). Examination of relationships among students' self-determination, technology acceptance, satisfaction, and continuance intention to use K-MOOCs. *Computers and Education*, *122*, 260-272. https://doi.org/10.1016/j.compedu.2018.01.003

Ke, W., & Zhang, P. (2010). The effects of extrinsic motivations and satisfaction in open source software development. *Journal of the Association for Information Systems*, *11*(12), 784-808.

Kennedy, J. (2014). Characteristics of massive open online courses (MOOCS): A research review, 2009-2012. *Journal of Interactive Online Learning*, *13*(1), 1-16.

Khan, I. U., Hameed, Z., Yu, Y., Islam, T., Sheikh, Z., & Khan, S. U. (2018). Predicting the acceptance of MOOCs in a developing country: Application of task-technology fit model, social motivation, and self-determination theory. *Telematics and Informatics*, *35*(4), 964-978. https://doi.org/10.1016/j.tele.2017.09.009

Klassen, R. M., Perry, N. E., & Frenzel, A. C. (2012). Teachers' relatedness with students: An underemphasized component of teachers' basic psychological needs. *Journal of Educational Psychology*, *104*(1), 150-165. https://doi.org/10.1037/a0026253

Kop, R. (2011). The challenges to connectivist learning on open online networks: Learning experiences during a massive open online course. *International Review of Research in Open and Distance Learning*, *12*(3), 19-38. https://doi.org/10.19173/irrodl.v12i3.882

Kramer, I. M., & Kusurkar, R. A. (2017). Science-writing in the blogosphere as a tool to promote autonomous motivation in education. *Internet and Higher Education*, *35*, 48-62. https://doi.org/10.1016/j.iheduc.2017.08.001

Kreijns, K., Vermeulen, M., Van Acker, F., & van Buuren, H. (2014). Predicting teachers' use of digital learning materials: combining self-determination theory and the integrative model of behaviour prediction. *European Journal of Teacher Education*, *37*(4), 465-478. https://doi.org/10.1080/02619768.2014.882308

Larionova, A. A., Zaitseva, N. A., Anoshina, Y. F., Gaidarenko, L. V., & Ostroukhov, V. M. (2018). The modern paradigm of transforming the vocational education system. *Astra Salvensis, 6*, 436-448.

Liyanagunawardena, T. R., Adams, A. A., & Williams, S. A. (2013). MOOCs: A systematic study of the published literature 2008-2012. *International Review of Research in Open and Distance Learning*, *14*(3), 202-227. https://doi.org/10.19173/irrodl.v14i3.1455

Loizzo, J., Ertmer, P. A., Watson, W. R., & Watson, S. L. (2017). Adult MOOC learners as self-directed: Perceptions of motivation, success, and completion. *Online Learning Journal*, *21*(2). https://doi.org/10.24059/olj.v21i2.889

Martin, N. I., Kelly, N., & Terry, P. C. (2018). A framework for self-determination in massive open online courses: Design for autonomy, competence, and relatedness. *Australasian Journal of Educational Technology*, *34*(2), 35-55. https://doi.org/10.14742/ajet.3722

Niemiec, C. P., & Ryan, R. M. (2009). Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice. *Theory and Research in Education, 7*(2), 133-144. https://doi.org/10.1177/1477878509104318

Pedrotti, M., & Nistor, N. (2016). User motivation and technology acceptance in online learning environments. *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 11th European Conference on Technology Enhanced Learning,* Lyon; 9891, 472-477. https://doi.org/10.1007/978-3-319-45153-4_45

Proulx, J. N., Romero, M., & Arnab, S. (2017). Learning Mechanics and Game Mechanics Under the Perspective of Self-Determination Theory to Foster Motivation in Digital Game Based Learning. *Simulation and Gaming*, *48*(1), 81-97. https://doi.org/10.1177/1046878116674399

Raes, A., Vanneste, P., Pieters, M., Windey, I., Van Den Noortgate, W., & Depaepe, F. (2020). Learning and instruction in the hybrid virtual classroom: An investigation of students' engagement and the effect of quizzes. *Computers and Education, 143*, 103682. https://doi.org/10.1016/j.compedu.2019.103682

Razumovskaya, M., Zaitseva N. A., Larionova, A. A., Chudnovskiy, A. D., & Breusova, E. A. (2018). Prospects for applying various forms of organizational integration to improve the quality of education. *Astra Salvensis, 6*, 348-362.

Robertson, S. (2018). Exploring the efficacy of training and development for liaison librarians at Deakin University, Australia. *Journal of Higher Education Policy and Management*, *40*(2), 107-120. https://doi.org/10.1080/1360080X.2018.1426370

Roca, J. C., & Gagné, M. (2008). Understanding e-learning continuance intention in the workplace: A self-determination theory perspective. *Computers in Human Behavior*, *24*(4), 1585-1604. https://doi.org/10.1016/j.chb.2007.06.001

Rogers, R. (2017). The motivational pull of video game feedback, rules, and social interaction: Another self-determination theory approach. *Computers in Human Behavior*, *73*, 446-450. https://doi.org/10.1016/j.chb.2017.03.048

Ryan, R. M., & Deci, E. L. (2017). *Self-determination theory: Basic psychological needs in motivation, development, and wellness.* New York: Guilford Publications.

Shi, L., & Cristea, A. I. (2016). Motivational gamification strategies rooted in self-determination theory for social adaptive e-learning. *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) 13th International Conference on Intelligent Tutoring Systems*, Croatia, pp. 294-300. https://doi.org/10.1007/978-3-319-39583-8_32

Sørebø, O., Halvari, H., Gulli, V. F., & Kristiansen, R. (2009). The role of self-determination theory in explaining teachers' motivation to continue to use e-learning technology. *Computers and Education*, *53*(4), 1177-1187. https://doi.org/10.1016/j.compedu.2009.06.001

Summers, J. J., Waigandt, A., & Whittaker, T. A. (2005). A comparison of student achievement and satisfaction in an online versus a traditional face-to-face statistics class. *Innovative Higher Education*, *29*(3), 233-250. https://doi.org/10.1007/s10755-005-1938-x

Sun, Y., Ni, L., Zhao, Y., Shen, X. L., & Wang, N. (2019). Understanding students' engagement in MOOCs: An integration of self-determination theory and theory of relationship quality. *British Journal of Educational Technology*, 50(6), 3156-3174. https://doi.org/10.1111/bjet.12724

Tan, Y. L. (2018). Meaningful gamification and students' motivation: A strategy for scaffolding reading material. *Online Learning Journal*, 22(2), 141-156. https://doi.org/10.24059/olj.v22i2.1167

Tschofen, C., & Mackness, J. (2012). Connectivism and dimensions of individual experience. *International Review of Research in Open and Distance Learning*, *13*(1), 124-143.

Vanslambrouck, S., Zhu, C., Lombaerts, K., Philipsen, B., & Tondeur, J. (2018). Students' motivation and subjective task value of participating in online and blended learning environments. *Internet and Higher Education*, *36*, 33-40. https://doi.org/10.1016/j.iheduc.2017.09.002

Vanslambrouck, S., Zhu, C., Tondeur, J., Phillipsen, B., & Lombaerts, K. (2016). Adult learners' motivation to participate and perception of online and blended environments. *Proceedings of the European Conference on e-Learning, 14th European Conference on e-Learning, ECEL 2015*, University of HertfordshireHatfield; United Kingdom, pp. 790-793.

Veletsianos, G., & Shepherdson, P. (2016). A systematic analysis and synthesis of the empirical MOOC literature published in 2013-2015. *International Review of Research in Open and Distance Learning, 17*(2), 198-221.

Wang, C. Hsu, H. K., Bonem, E. M., Moss, J. D., Yu, S., Nelson, D. B., & Levesque-Bristol, C. (2019). Need satisfaction and need dissatisfaction: A comparative study of online and face-to-face learning contexts. *Computers in Human Behavior*, 95, 114-125. https://doi.org/10.1016/j.chb.2019.01.034

Yang, S., Zhou, S., & Cheng, X. (2019). Why do college students continue to use mobile learning? Learning involvement and self-determination theory. *British Journal of Educational Technology*, *50*(2), 626-637. https://doi.org/10.1111/bjet.12634

Zaitseva, N. A., Larionova, A. A., Nikolay, I. Shapovalov, N. I., Povorina, E. V., Takhumova, O. V., Zhukova, M. A., & Dvornikova, T.A. (2020). Regulatory aspects and problems of personnel certification taking into account the requirements of professional standards. *International Journal of Psychosocial Rehabilitation, 24*(03), 2179-2188. https://doi.org/10.37200/IJPR/V24I3/PR200966

Zhou, M. (2016). Chinese university students' acceptance of MOOCs: A self-determination perspective. *Computers and Education, 92,* 194-203. https://doi.org/10.1016/j.compedu.2015.10.012

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