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AN EXPLORATORY ANALYSIS OF THE DETERMINANTS OF MOOC AUTHORSHIP AMONG RUSSIAN ACADEMICS

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Research on Massive open online courses (MOOCs) and their effect on the development of the higher education (HE) sector has expanded over the last ten years. However, little is known about the determinants of MOOC adoption by academics. This study tests a proposed model that integrates individual and institutional level determinants of MOOC authorship. In particular, this article examines the variety of structural and cultural factors on two levels to propose a model of MOOC authorships based on data from 8,935 academics derived from the "Monitoring of Education Markets and Organisations" database.[3] The study confirmed the significant impact of structural factors, but also emphasised the importance of individual cultural factors (attitude towards MOOCs, self-efficacy with regard to possessing advanced online learning design skills) and institutional cultural factors (university commitment to MOOCs). The intent to design an online course and self-efficacy regarding the possession of advanced online learning design skills are the most influential variables. The proposed model explains 77% of the combined impact of individual and institutional factors on academics' decision to design a MOOC (or online course). Based on the study findings, recommendations for planning academics' professional development are suggested.

Keywords: MOOC authorship, MOOC adoption, online courses, Russian higher education, online education, EdTech.

JEL Classification: I29.

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[3] https://memo.hse.ru/en/

1. Introduction

Massive open online courses (MOOCs) entered the educational market at the beginning of the 21st century, with new digitalisation trends emerging in global education. Rapid technological advancements in telecommunications have precipitated the emergence and the advancement of a new online learning mode (Bond, 2013; deWaard et al, 2011; Mallon, 2013; Nyoni, 2013). MOOC technology was further enhanced by the ongoing artificial intelligence (AI) evolution (Torres-Díaz, Infante Moro, & Valdiviezo Díaz, 2014; Zhu, Sari, & Lee, 2022). The COVID-19 pandemic has provided the final push toward the global acceptance of the digitalisation of higher education (HE) and the introduction of MOOCs in particular as the pandemic led to the lockdown of many physical educational institutions (Sun, Xiong, Li, Chen, Tang, Hua, & Mao, 2022).

The global digital transformation of HE and issues related to the massification of HE have resulted in a shift in the research agenda. Currently, most countries pursue comprehensive educational reforms, e.g. digitalisation (Gerrard, 2015; Zepke, 2018), open access and the massification of education (Literat, 2015; Akalu, 2016; Tikhonova & Raitskaya, 2018), the prioritisation of teaching and research excellence, competitiveness, and rankings (Mok, 2015; McCoy et al., 2018; Milian & Rizk, 2018), and educational quality reforms (Minina, 2017; Cheng, 2017; Scharager, Goldenberg, 2018), aimed at the transformation of HE (Tikhonova & Raitskaya, 2018).

In the era of globalisation and digitalisation, MOOCs offer a promising way to tackle such problems such as access to HE for learners from low socio-economic backgrounds, those who live in remote areas, and students with disabilities. Equality in, access to, and the inclusivity of MOOCs is a popular international research topic, with attention recently placed on the particular features of technology that can address the diversity of student needs (Clow, 2013; Liyanagunawardena, Adams, & Williams, 2013; Han & Lee, 2022). Access to MOOCs for learners with disabilities is also mentioned among requirements to realise their full potential (see Iniesto, McAndrew, Minocha, & Coughlan, 2022). Furthermore, the internationalisation and massification of HE have been promoted by politically motivated or socially influenced trends, such as increasing academic and research mobility, the development of educational technologies and AI, and growing competition in educational and education technology markets (Tikhonova & Raitskaya, 2018; Komljenovic, 2021). Another global trend is interest in local online courses, which, compared to the MOOC giants, represent an entirely new ecosystem. This type of ecosystem has spread around the world and operates in multiple languages with university and corporate regional partners finding benefits of local MOOCs, including their attraction for the larger local population with more inclusive demographic profiles and better tailoring for the needs of local students.

The COVID-19 pandemic revealed weak areas in the readiness of the HE sector for the transition to online learning. The ready-to-use MOOCs became a more common choice as a supplemental method for teaching and learning (Sun, Xiong, Li, Chen, Tang, Hua, & Mao, 2022). However, Tseng, Lin, Wang, and Liu (2022) found that despite the popularity of MOOCs, they were less favoured by academics during the pandemic compared to the use of other distance learning and educational technologies. In another study, Sun and colleagues (2022) showed that the pandemic pushed more people to choose MOOCs as a mode of learning, but the risk that online education could exacerbate rather than reduce disparities related to the socioeconomic status of learners was confirmed. Nevertheless, the trend of technology-mediated education becoming more and more integrated into modern teaching and learning suggests that the hybrid learning model will support education after COVID-19. Furthermore, the pandemic raised the importance of the issues of learner support and well-being which are also likely to stay on the research agenda (Okoye, Rodriguez-Tort, Escamilla, & Hosseini, 2021).

De Freitas, Morgan, and Gibson (2015) emphasised the polarised debate around the potential of MOOCs to transform HE (Kaplan & Haenlein, 2016). On the one hand, the features of MOOCs are different from other modes of online learning in that they allow open access for an unlimited number of participants (Alraimi, Zo, & Ciganek, 2015; Kaplan & Haenlein, 2016). Similarly, Daradoumis, Xhafa, and Caballé (2013) argued that MOOCs based on open educational resources are one of the most versatile ways to offer access to quality education, especially for those residing in distant or disadvantaged areas. On the other hand, Margaryan, Bianco, and Littlejohn (2015) pointed out that although most MOOCs are well-structured and organised, the quality of their instruction is still lacking. Furthermore, research emphasised such issues as low completion rates (see Jordan, 2014; lraimi & Ciganek, 2015). To overcome these hurdles large-scale learning analytics for prediction, control, and learner support in MOOCs need to be utilized (Ruipérez-Valiente, Staubitz, Jenner, Halawa, Zhang, Despujol, Maldonado-Mahauad, Montoro, Peffer, Rohloff, Lane, Turro, Li, Pérez-Sanagustín, & Reich, 2022; Fotso, Batchakui, Nkambou, & Okereke, 2022; Manasa, Seetha, & Viswanadha Raju, 2021). The use of learning analytics, such as statistics, machine learning and data visualisation methods in researching MOOCs is a growing trend, however learning analytics is mostly concerned with research rather than its practical application to increase student retention and facilitate their engagement (Zhu, Sari, & Lee, 2022).

The issues discussed above have been predominantly researched from the perspectives of learners, in regard to institutional strategies for implementing MOOCs (Guerrero, Heaton, & Urbano, 2021; Liyanagunawardena, Adams, & Williams, 2013) or senior management in universities (Allen & Seaman, 2015). There is little work published that focuses on the pedagogical aspects of MOOCs or the examination of determinants of MOOC adoption in regard to those involved in teaching. Academics may be driven to use MOOCs (or online courses) by such factors as personal interest, publicity, improving the quality of teaching, or benefits and incentives (Lowenthal, Snelson, & Perkins, 2018; Sheard et al., 2014). Such barriers as quality concerns, insufficient English language skills (Gulatee & Nilsook, 2016) and the worry about traditional aspects of the university experience "becoming obsolete" are also articulated (Sheard et al., 2014, p. 137). In Russia, research has studied the demand for MOOCs in HEIs, the use of MOOCs for professional development (Bekova et al., 2020; Roshina, Roshin, & Rudakov, 2017; Semenova & Rudakova, 2016), and the transformative effect of MOOCs on Russian HE (see Aynutdinova & Aynutdinova, 2017; Kuzminov & Carnoy, 2015). Yet, such studies did not take into account those academics who have already designed their own online courses, despite the pivotal role of academics in the implementation of digitalization plans at the institutional level (Efimov & Lapteva, 2019). This research aims to fill this gap in the literature. It explores the individual and institutional factors that determine MOOC adoption among academics. The article focuses on MOOC and online course authorship among academics in the Russian context and addresses the following research question: *What factors determine Russian academics' intention to design their own MOOC (or online course)?* The conceptual framework proposed by Tondeur, Valcke, and Van Braak (2008) was used in the exploratory analysis.

The importance of this research comes from two considerations. First, as the literature search showed, there are no studies that explore academics' behaviour towards designing their own MOOC (or online course). Thus, the study findings provide the research community with new insights into the determinants of such behaviour. Secondly, this study is unique in that it employs a machine learning algorithm to explore a wide range of factors at four levels of influence. The same method can be used to examine additional relevant variables to improve the model performance and its predictive power.

The paper is organised as follows. The second section contains a literature review. The third section introduces the conceptual framework. The fourth section is dedicated to methodology and methods. The following section discusses the results of the study. The final section provides conclusions and recommendations.

2. Literature review

2.1 Massive Open Online Courses

MOOCs are a relatively new yet extremely popular phenomenon with a global reach (Liyanagunawardena, Adams, & Williams, 2013). The concept of MOOCs was first articulated in relation to the "Connectivism and Connective Knowledge" course created in 2008 by Alexander and David Cormier (Downes & Siemens, 2010). The features of a MOOC were different from previous approaches to online education (Alraimi, Zo, & Ciganek, 2015; Kaplan & Haenlein, 2016), e.g. open-access that allowed for unlimited participation. Furthermore, participation in a course with no intent to earn university credits was free, allowing anyone with the Internet to enrol.

Among the first promoters of the idea of open-access university courses was Massachusetts Institute of Technology (MIT). By 2012, MIT made more than 2,150 of its courses freely available (MIT OpenCourseWare Program Evaluation Findings Summary report, 2013). The discussion on how to enable free access to education for the global population was also elaborated by UNESCO (UNESCO, 2002). In 2002, UNESCO first introduced the concept of "open educational resources" for the benefits of humanity. World famous universities' open education initiatives and the promotion of free HE by UNESCO, coupled with the rise in Internet access, were among major facilitators for the advancement of MOOCs.

Interest in MOOCs around the global educational community has been growing with the growth of MOOCs (Clow, 2013) (Figure 1), with the majority of studies conducted in the US, China, the UK, and Spain (Figure 2).

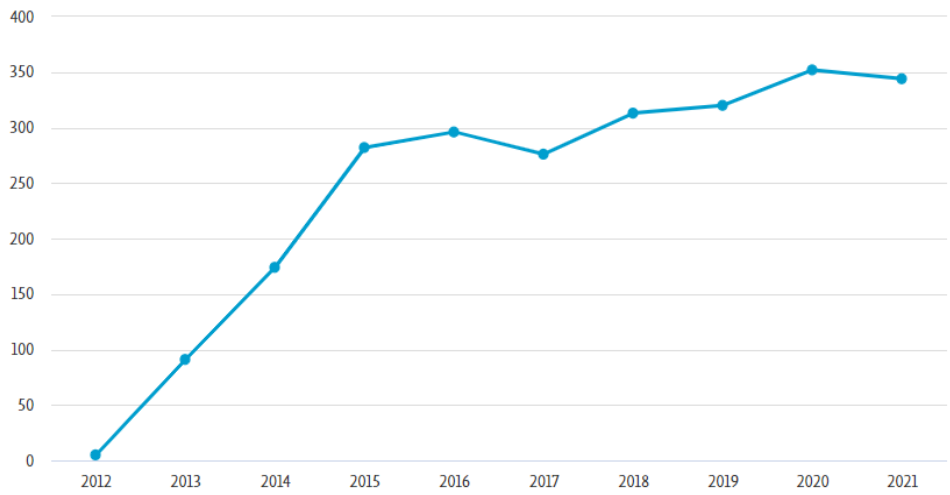

Figure 1. Distribution of publications on MOOCs by year[4]

[4] n= 2480, search terms "massive open online courses", "moocs" and "higher education", "tertiary education", "online higher education", "online learning", "distance education", "distance learning".

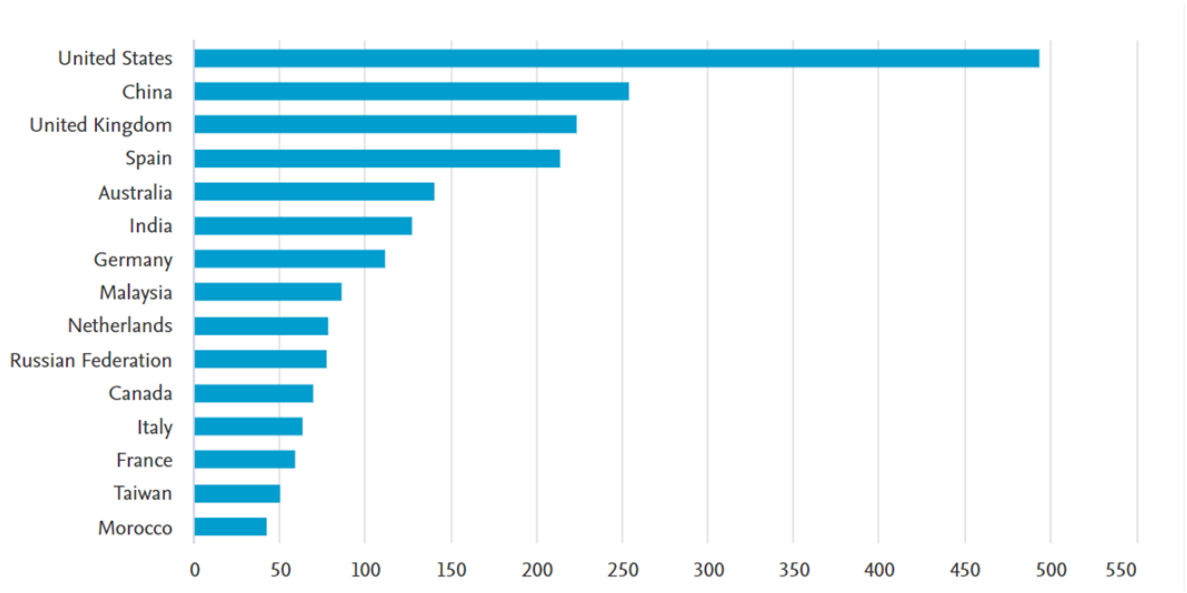

Figure 2. Distribution of publications on MOOCs by country[5]

The literature suggests that at an individual level, university academics have different rationales for engaging with MOOCs, starting with personal interest, passion about new educational technologies, personal publicity and marketing, but also driven by the benefits and incentives offered by their institutions (Lowenthal, Snelson, & Perkins, 2018). Eckerdal et al. (2014) found that while educators acknowledge the affordances and potential benefits of MOOCs, only a small number were willing to use them as resources for teaching and learning.

Many of the early developed digital learning environments were not sophisticated enough to be accepted by teachers who tended to prefer traditional ways of educational delivery. Although online learning technologies were available even in the 1990s (Hill, 2012), they were technologically rather than pedagogically oriented. Among the common concerns expressed by academics were a poor understanding of online learning and assessment design, and a lack of social interaction among peers and instructors. Furthermore, since it is impossible to support and respond to all students' needs, the design of a course, the structure of its materials and its pedagogical approach and rigour are the main criteria of MOOC quality. Compared to other open educational resources, MOOC materials have to be structured with students in mind, applying the principles of learning design and considering the best practices in creating online learning content (Pappano, 2012). Yet, a lack of faculty motivation to embark on pedagogical changes was reported among the primary barriers to MOOC adoption (Carson, 2012, Rotar, 2021).

During the COVID-19 pandemic, the examination of educators' experiences of MOOC utility point to the growing acceptance of MOOCs in HE. For instance, Okoye, Rodriguez-Tort, Escamilla, and Hosseini (2021) found that, according to study participants, the pandemic, although disrupting many areas of human and organisational ventures worldwide, facilitated the utilisation of innovative technologies and strategies developed by educators to foster the rapid transition to online learning. For HEIs, technology-mediated education has become an integral part of reality during the pandemic, when digital technologies have consequently become an inevitable and

[5] n= 2480, search terms "massive open online courses", "moocs" and "higher education", "tertiary education", "online higher education", "online learning", "distance education", "distance learning", limited to 15 countries.

indispensable part of learning. According to the 98% of teacher respondents from Saud Arabia, the pandemic emergency was the gateway for digital transformation in education and that it will expand further in a post-pandemic world (Alabdulaziz, 2021). Despite this prognosis, the perception of MOOCs is varied among educators. Donitsa-Schmidt, Ramot, and Topaz (2022) identified distinctive profiles of MOOC users, e.g. those who are focused on its potential benefits, those who valued only specific features of MOOCs, and those who adopt a utilitarian approach, regarding MOOCs as a temporary way to overcome time and space barriers to education.

Despite the limitations of MOOCs, the low-cost scalability of technology-enhanced learning, which also offers an opportunity to monitor student progress, made distance learning programs popular among educators. The global expansion of technology in HE during the pandemic also suggests that a hybrid model of education, with the inclusion of MOOCs and other forms of online courses into the formal curriculum, will flourish in the future. However, scholarly debate on the potential of MOOCs to democratise HE through open access to high-quality online courses for all students, including those who were previously excluded from HE, is ongoing (Daradoumis, Xhafa, & Caballé, 2013; De Freitas, Morgan, & Gibson, 2015). Furthermore, the pandemic introduced the importance of the issues of learner support and well-being which are likely to remain a part of the future research agenda (Okoye, Rodriguez-Tort, Escamilla, & Hosseini, 2021). Finally, the urgent need to transfer traditional courses into an online learning environment showed a lack of educators' knowledge and skills about the basic principles of online learning design and the criteria for online course quality (Rotar & Peller-Semmens, 2021).

2.2 The case of Russia

In focusing on the Russian context, where this study was conducted, the research on MOOCs is primarily driven by the increasing integration of online courses into HE (Semenova, Vilkova, & Shcheglova, 2018). Only recently has HE in Russia been undergoing transformative changes related to the introduction of educational technologies (Aynutdinova & Aynutdinova, 2017; Bekova et al., 2020; Kuzminov & Carnoy, 2015; Krokhmal, 2017). Studies show that tolerance towards MOOCs has increased over the last few years. Sukhostavtseva and Rudakov (2021) and Rotar (in press) report that in Russia, almost 50% of Russian academics used MOOCs (or online courses) in teaching and in preparation for teaching, and about 17% of academics have designed their own MOOC, showing an increase over recent years. A rapid adoption of MOOCs (or online courses) can be explained by a number of factors. First, governmental and institutional policies on the digitalisation of education.[6] For instance, the Russian national project "The modern digital educational environment" aims to significantly increase the number of online courses offered by HEIs (Bekova et al., 2020). On an institutional level, digitalisation efforts include the design of virtual and augmented reality simulators with online courses as a part of a gamification strategy, the development of online environments for monitoring teaching, research and administrative activities, an increase in the number of students who completed online courses on digital literacy and digital economy skills in accordance with the programme "Digital competences". Individual universities, e.g., HSE university, have established online learning design teams that gather staff with differentareas of expertise. For other universities, the strategy is structured around professional development and the expansion of online education through hybrid teaching and

[6] See such documents as the Decree of the Ministry of Education of the Russian Federation "On approval of guidelines for the introduction of modern digital technologies into main educational programs" (2020); the Decree of the Government of the Russian Federation "On the state information system "Modern digital educational environment" (2020); the Decree of the Government of the Russian Federation "On the approval of the development program of the FGBOU HE "Saint Petersburg State University" for 2021-2030 (2021); the Decree of the Government of the Russian Federation "On approval of the development program of the Federal State Autonomous Educational Institution of Higher Education "National Research University Higher School of Economics" until 2030 (2021).

learning (e.g., Moscow State Pedagogical University, Kursk State University, Ural Federal University). Other HEIs have adopted a partial (e.g., Tomsk State University, Siberian Federal University) or full (e.g., HSE University, the Moscow Institute of Physics and Technology, Peter the Great St. Petersburg Polytechnic University) replacement of face-to-face courses by the online courses. It is also important to point out that there is a separate governmental strategy in Russia encompassing a range of the so-called "flagship", or leading universities, dictating the peculiarities of their digital transformation and evolution, and determining the grant sizes supporting digitalisation tasks.

The pressure on individual academics to use online learning technologies, including MOOCs and local online courses, also increased due to the COVID-19 pandemic, when emergency governmental policies required educational providers to transfer all teaching and learning online. To better understand academics' attitudes towards the rapid digitalisation before and during the pandemic, individual experiences were collected (Novikova, Bychkova, & Novikov, 2021). The authors reported that although academics expressed confidence in embarking on the use of digital resources, their preference was predominantly for the traditional mode of teaching. Educators pointed out such limitations of online learning as the lack of personal contact, challenges with providing feedback, and the monitoring of students. Furthermore, the effective use of digital tools was compromised by technical problems and different levels of competence among the educators (Novikova et al., 2021). Narbut et al. (2020) also studied the transition of Russian universities to online education during the pandemic by surveying 3467 academics from all federal districts in Russia. They found that about 50% of academics believed that educational delivery was provided adequately during the pandemic but the quality of teaching suffered. At the same time, 31% of academics thought that the quality of education was equal to the traditional delivery model. The study concluded that Russia's academics displayed confidence in their adaption to online learning during the pandemic. The analysis of MEMO 2020 data on MOOC adoption in Russia indicates an increase of online course users among academics (Suhostavtseva & Rudakov, 2021; Rotar, in press). The data also shows that about 18% of academics had designed a MOOC (or online course) and almost 60% intended to design their own online course.

The integration of online courses into HE is not straightforward as the process of MOOC (or online courses) adoption. It is a complex phenomenon that is influenced by the interaction of different interests, needs, drivers and barriers. The initiatives on digitalisation were planned before the pandemic, but with the rapid evolution of online education, academics are puzzled (to borrow a term from Maassen et al., 2012) by a situation where they resist the change yet have to adapt to it. As Soltovets et al. (2021) emphasised, despite "some tertiary institutions deploying a network of semi-finished educational services, most employees found themselves in a "sink-or-swim" position, feeling swept by the tidal wave of technical issues and digital teaching products on offer" (p. 5). Despite MOOCs and other forms of online courses becoming an integral part of the learning process (Bekova et al., 2020), interest in MOOCs (or online courses) in Russia is still developing. Not much work has been done to explore its effect on the Russian educational system, with a particular lack of research on MOOC (or online courses) adoption and acceptance by academic staff. Studies have examined the demand for MOOCs in Russian universities of different types and the use of MOOCs for professional development (Bekova et al., 2020; Semenova & Rudakova, 2016). A few papers touch upon the history, the market of Russian MOOCs and its transformative effect on Russian HE (see Aynutdinova & Aynutdinova, 2017; Kuzminov & Carnoy, 2015; Roshina, Roshin, & Rudakov, 2017; Semenova, Vilkova, & Shcheglova, 2018). Using the MEMO dataset from 2015–2016, Roshina et al., (2017) explored the demand factors for MOOCs among students and faculty members. They showed that faculty members of private educational institutions and specialisations such as the humanities, medicine, economics, law, and agriculture, had more positive attitudes towards MOOCs. Although providing a significant contribution to

understanding the demand factors for MOOCs, Roshina et al. (2017) explore only one aspect of MOOC adoption among academics, specifically their use for professional development and individual purposes. Sukhostavtseva and Rudakov (2021) described the attitudes of academics towards the integration of MOOCs (or online courses) into the formal grading system, and their adoption by academics of different age groups and academic disciplines. However, the authors only focused on MOOCs (or online courses) acceptance in teaching and in preparation for teaching, but not on MOOC (or online course) authorship or the readiness of academics to produce their own online courses. The opinions of academics on the implementation of online courses have also been investigated by Prohorova and Vaganova (2019). The authors interviewed 45 academics from Minin University in the 2017–2018 academic year to explore their perceptions of and attitudes towards MOOCs. They found that approximately one-third of academics were interested in learning more about MOOCs, suggesting a need for informing academics about the potential and limitations of such online courses. However, in their university, only 18% of academics indicated an intent to design their own MOOC, mainly because of the increased workload. Furthermore, 89% of academics expressed a need for support in developing online courses and financial compensation for the time invested.

While studies provide evidence of academics' awareness of MOOCs, drivers of demand for MOOCs in Russian HE, MOOC use in teaching and for professional development (Roshina et al., 2017; Sukhostavtseva & Rudakov, 2021), and investigating educators' perspectives regarding the advantages and disadvantages of MOOCs (Zakharova & Tanasenko, 2019), research has not considered cases of academics who have already designed their own online course. As a result, factors that encourage or prevent Russian academics producing a MOOC (or online course) remain under researched. For the successful integration of MOOCs (or online courses) into HE, a keen understanding of what leads academics to adopt new educational technologies is critical. As Trehan and Joshi (2018) argues that "the drivers of MOOC adoption" by academics need to be continuously explored (p. 38).

3. Conceptual framework

The conceptual framework shows how the researcher "theorises or makes logical sense of the relationship among the factors identified as important to the problem" (Sekaran, 1992, in Akour, 2009, p. 104). The framework presents hypothesised ideas that can be further tested through the statistical methods. To navigate through the variety of potentially influencing factors reported in the literature, the application of a conceptual framework to explore the determinants of MOOC authorship in this study is helpful. I adopt the framework by Tondeur, Valcke, and van Braak (2008) to investigate the determinants of technology use (Figure 3). The conceptual framework allows the grouping of variables considered important for this study and shows the relationships among the groups based on the literature on educational technology adoption.

In the centre of the framework is the dependent variable, which is MOOC authorship. The dependent variable is surrounded by numerous factors at two levels, individual and institutional. Additionally, the authors distinguish two categories of characteristics for each level: structural and cultural.

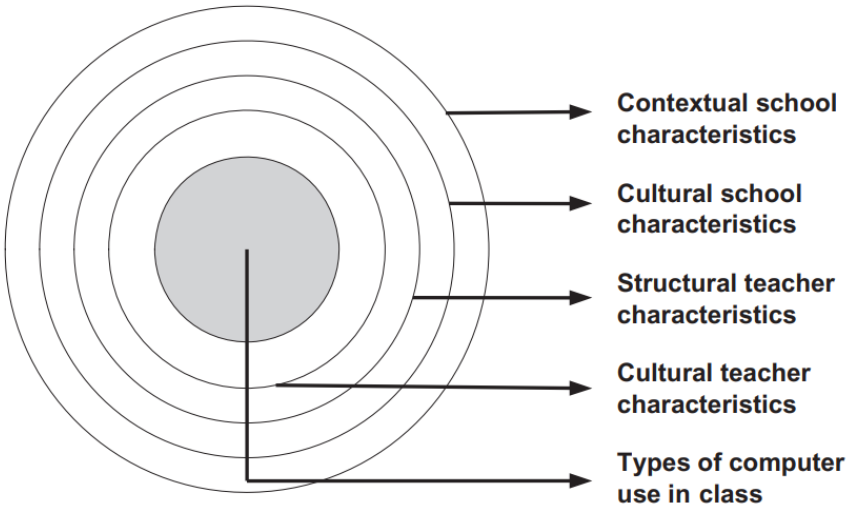

Figure 3. Conceptual framework (source: Tondeur et al., 2008)

Tondeur et al.'s (2008) framework has been widely used in research on school teachers' acceptance of educational technology and its integration in the classroom. However, the research provides grounds to belief that this framework can also be applied in HE.

First, a number of cross-cultural studies conducted in HE showed that cultural values influence the views and opinions of individuals (Huang et al., 2019; Huang et al., 2021). Cultural values are commonly held subjective "standards or principles of what is acceptable or unacceptable, important or unimportant, right or wrong, workable or unworkable, etc., in a community or society" (Hofstede, 2008, in Huang et al., 2021, p. 1272). The examination of cultural values in regard to education in Russia using Hofstede's cultural dimensions has been done in the past (see Pogosian, 2016; Damary, Markova, & Pryadilina, 2017; Makhmutova, & Zialtdinova, 2019). Yet, in this study, cultural characteristics are seen as more intimate in relation to the dependent variable, including beliefs or attitudes towards a particular technology (Tondeur et al., 2008). Although individual biographical factors (e.g., gender, age) or acquired characteristics (e.g., education, experience) are common variables in research at all educational levels, the effect of cultural factors on technology use has been predominantly examined for schoolteachers (see exceptions by Huang et al. 2019a, b, c, and Huang et al., 2021). However, as Huang et al. (2021) emphasised, an examination of the influences of cultural values on the acceptance of educational technology and its use among HE teachers should not be neglected. Second, the influence of institutional factors on shaping individuals' beliefs and behaviour has been theorised in institutional theory (Scott, 1995). The effect of institutional culture, referred to as positive expectations and available support, on facilitating and encouraging the technology use, has been found not only at the school level, but also at the level of teacher training (Lai, Wang, & Huang, 2022).

The application of the conceptual framework in HE is discussed in the following part of this section.

Individual cultural characteristics

In this study, cultural characteristics represent different aspects of an individual academic's *beliefs and the psychological factors* that may affect the adoption of educational technology. In a number of technology acceptance studies, individuals' attitudes towards technology are characterised by

attitude, anxiety, and beliefs. It is suggested that a feeling of doubt or fear about technology use has an indirect effect on its adoption (Chow et al., 2012; Sánchez-Prieto et al., 2017; Venkatesh et al., 2003). A negative or positive attitude towards technology may either facilitate or hinder its adoption and use (see Adov et al., 2020; Sánchez-Prieto et al., 2017).

Another psychological attribute mentioned in the technology adoption research is confidence about one's ability to use the technology, or *self-efficacy* (see e.g., Gil-Flores et al., 2017; Kreijns et al., 2013). Computer self-efficacy is a significant predictor of its use (Compeau and Higgins, 1995). Their argument was based on Social Cognitive Theory (Bandura, 1977) which suggests that behaviour is linked to individuals' perception of their ability to perform a particular task. Lopez and Manson (1997) found that computer self-efficacy has a significant influence on usage, whereas Park and Chen (2007), who focused on the use of smartphones, confirmed the effect of self-efficacy on the behavioural intention. Finally, the role of *behavioural intention* as a predictor of technology use has been well-supported by technology acceptance research (Ajzen, 1991; Venkatesh et al., 2012).

In this study, I explore the effect of academics' attitude towards MOOC implementation into the formal HE system. Three variables, an academic's attitude towards full or partial integration of MOOCs into the formal curriculum, an intent to design their own MOOCs, and self-efficacy regarding online learning design skills were included in the analysis.

Individual structural characteristics

Research on the adoption of educational technology emphasises that demographic variables, such as *age and gender*, influence individuals' decisions on its adoption. Sailong, Kumar, and Kerry (2020), Abu-Shanab and Ababneh, (2015), and Wrycza and Kuciapski (2018), among others, confirmed the moderating effect of age and gender on e-learning and mobile technology adoption by academics. In technology acceptance research, gender and age effects were studied by Venkatesh and Morris (2000), who found that gender is an important determinant of technology usage.

Another factor that has been identified as an important predictor of educational technology adoption is *prior experience of technology use* (Koutropoulos et al., 2012; Semenova & Rudakova, 2016). Researchers suggest that if experience of a particular innovation is absent, previous experience with the use of technology is an important factor when examining behaviour (Akour, 2009; Jiang et al., 2000). Sukhostavtseva and Rudakov (2021) found that academics who have previously used online courses in practice are more likely to favour the formal integration of MOOCs into the HE system. In a study on MOOC adoption, Semenova and Rudakova (2016) found that previous experience with online learning significantly affects individuals' attitudes towards MOOCs.

Among important factors emphasised in the research is the *workload* associated with online course design. An increase in workload for faculty members, as a barrier in designing online courses (Ziegenfuss & Furse, 2016; Singleton et al., 2019). Additionally, insufficient *English language skills* was a barrier to educational technology use (Gulatee & Nilsook, 2016). On the contrary, it is suggested that good knowledge of English facilitates MOOC adoption (Chen, 2013; Gulatee & Nilsook, 2016).

To explore the effect of these variables, I examine the effect of demographic characteristics (three variables related to past experience of MOOC use in professional practice, experience of work in an online learning environment, and experience of studying in MOOCs); the effect of workload, and the effect of English language skills. Among other structural individual characteristics included into the analysis are PhD *degree* and *seniority of research or teaching position*.

Institutional cultural characteristics

In this study, cultural factors are presented through the university commitment construct. Research on university commitment is associated with the concept of university support that may incorporate support from management, the provision of training and technical support, and other forms of individual adoption of technology (Moore & Benbasat, 1991; Park & Chen, 2007).

In this study, university commitment construct contains two variables, namely *financial rewards* for academics who use educational technologies in their practice and the *institutional practice of MOOC use*. Financial rewards for the use of technology indicate a positive attitude towards it on an institutional level. On a contrary, a lack of financial incentives is a barrier to online learning design among academics (Singleton et al., 2019). The inclusion of the second variable, the presence of MOOCs in a higher education institute (HEI), is supported by research on the diffusion of innovations (Moore & Benbasat, 1991). Sukhostavtseva and Rudakov (2021) also found that the attitude of academics towards MOOCs is more favourable in HEIs which had experience in offering MOOCs (among academics who work in such HEIs, 68% of them reported a positive attitude towards replacing traditional courses with MOOCs).

Institutional structural characteristics

Structural institutional characteristics are introduced as control variables, including the location (Moscow vs other region), size, status (participant in Project 5-100, Research-oriented, Public). Justification for the inclusion of structural institutional factors into the analysis comes from studies on digitalisation efforts across HEIs in Russia. Perevalov et al. (2020) emphasized that in Russia, the implementation of educational technologies depends on a HEI's profile, including its status.

3 Methodology and methods

3.1 Data collection

The data was derived from the "Monitoring of Education Markets and Organisations" (MEMO) 2020 database. MEMO data was selected because it provides up-to-date information on MOOC (or online course) adoption by academics across Russia, including data on MOOC (or online course) authorship. The MEMO survey has methodologically verified sampling and data collection procedures and has been used since 2003. The subset of data used in the analysis included responses from 8,935 academics working across public and private universities in Russia. A description of selected variables derived from the literature review, and their characteristics, are presented in Table 1.

Table 1. Variable definitions

	Dependent variables
MOOCs author	=1 if an individual designed an own MOOC
	Independent variables
MOOCs use	=1 if an individual used MOOCs in teaching or in preparation for teaching
MOOCs learning	=if an individual has experience of successful completion of a MOOC (or online course).
Self-efficacy	=1 if an individual reported an advanced skills of online learning design.
University MOOCs use	=if MOOCs are available at the HEI where an individual works.
BI (behavioural intention)	=if an individual expressed an intent to design own MOOC in the next 12th months.
Financial incentives	=1 if a HEI where an individual works offers incentives for the use of EdTech or ICT
Shtat	=1 if an individual works at the HEI on a full-time contract, either permanent or fixed-term.
Research HEI	=1 if a HEI where individual works is research oriented
5-100	=1 if a HEI where individual works is a participant of the national Project 5-100[7], which aims to maximise the competitive position of leading Russian universities.
Moscow	=1 if a HEI where an individual works is located in Moscow
Small	=1 if HEI is small (up to 1000 people)
Public	=1 if a HEI is public.
Senior	=1 if an individual holds a position of professor, assistant professor, or a senior researcher.
English	=1 if an individual has English language skills.
wage	Continuous variable, average wage for the last 12 months, log-transformed
Doctor of Sciences	=1 if an individual holds a Doctor of Science degree.
Candidate of Science	=1 if an individual holds a Candidate of Science degree
PhD	=1 if an individual holds a PhD degree.
male	=1 if an individual is male
age	Continuous variable, an individual's age, normalised.

3.2 Data analysis

3.2.1 Recursive feature elimination method with cross-validation

Automatic feature selection methods can be used to build many models with different subsets of the main dataset to identify attributes to build an accurate model. Recursive Feature Elimination

[7] https://5top100.ru/en/

(RFE) is a popular method for feature selection that uses a Random Forest algorithm on each iteration to evaluate the model. RFE is a wrapper method that treats variables as black boxes and aims at finding a feature subset that has the minimum cross-validation error on the training data (Yan& Zhang, 2015). The algorithm is configured to explore all possible subsets of the variables.

To select an optimal number of predictors for MOOC (or online course) authorship, I employed a RFE algorithm in machine learning. By removing irrelevant and noisy variables from the original data set, RFE solves the problem of model overfitting and helps to improve its overall performance (Yan & Zhang, 2015).

To apply the RFE method, I split the dataset into two subsets (20% and 80%). The larger subset was used for training on all the selected variables, evaluating their significance, removing the least significant ones, and so on, until the optimal number of the most relevant variables were found.

3.2.2 Assessment of the model's predictive power

At the final step, the model was tested for its predictive power. Since there was a class bias in the data subset (the proportion of MOOC or online course authors was much smaller than the proportion of non-authors), in order to get better results, observations for testing and training were sampled in approximately equal proportions.

4 Results and discussion

4.1 Descriptive statistics

Table 2 presents the descriptive statistics. Of the academics, 62% are female and 38% are male; 47% of them used MOOCs (or online courses) in professional practice and 29% completed at least one MOOC (or online course); 18% reported possessing advanced online learning design skills; 18% designed their own MOOC (or online course)—although in absolute numbers there are more academics with online learning design skills than MOOC (or online course) authors. A large number of academics, about 60% of the sample indicated an intention to design their own MOOC (or online course) in the next year.

Table 2. Descriptive statistics

	Frequency	**Mean**	**SD**	**Min**	**Max**
MOOC authorship	9255	0.18	0.39	0	1
MOOCs use	9255	0.47	0.50	0	1
MOOCs learning	9255	0.29	0.45	0	1
Intent to design a MOOC	9255	0.58	0.49	0	1
Financial incentives	13369	0.07	0.25	0	1
University use of MOOCs	9255	0.53	0.50	0	1
LD skill	13369	0.18	0.39	0	1
English	13369	0.66	0.47	0	1

	Frequency	Mean	SD	Min	Max
Attitude (full implementation)	8941	0.73	0.45	0	1
Attitude (partial implementation)	9255	0.48	0.50	0	1
Workload	9255	0.37	0.48	0	1
male	13369	0.38	0.49	0	1
age	13369	47.85	12.18	15	84
Candidate	13369	0.61	0.49	0	1
PhD	13369	0.01	0.11	0	1
senior	13369	0.36	0.48	0	1
Shtat	13369	0.90	0.30	0	1
Moscow	13369	0.14	0.34	0	1
Small	13369	0.22	0.41	0	1
Public	13369	0.97	0.16	0	1
Research HEI	13369	0.12	0.33	0	1
5-100	13369	0.08	0.27	0	1

More than half of academics (53%) reported that MOOCs (or online courses) have been used in their university as a partial or full replacement of traditional courses. However, only 7% said that their university offers financial incentives for the use of educational technology in their practice.

In terms of individual cultural factors, 73% of academics expressed a positive attitude towards MOOCs (or online courses) fully replacing selected offline courses, and 48% of academics expressed a positive attitude towards MOOC (or online course) integration into the curriculum following a blended learning model.

4.2 RFE and regression results

Figure 4 visualises the number of features selected through the RFE method, along with the cross-validated test scores.

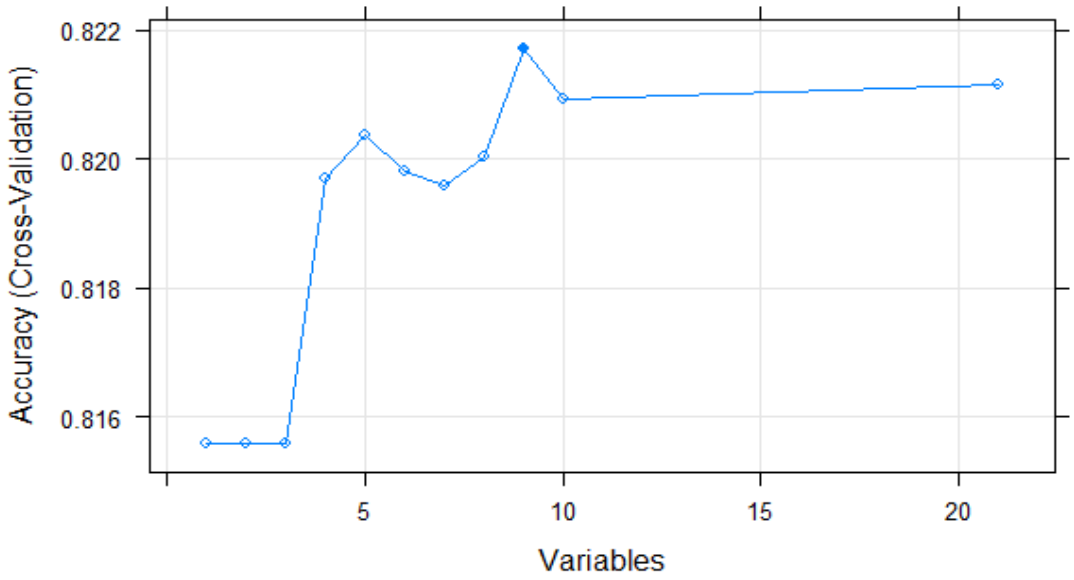

Figure 4. RFE results with accuracy scores

The optimal number of variables that determine MOOC (or online course) authorship is nine, including the intention to design a MOOC (or online course), experience of MOOC use in professional practice, confidence in one's advanced learning design skill, MOOC learning experience, institutional practice of MOOC use, HEI participation in Project 5-100, financial incentives for the use of technology, and a positive attitude towards the full replacement of specialised courses by MOOCs.

All variables computed using the RFE method were selected to build a predictive model of MOOC (or online course) authorship. Table 3 shows the results of the logistic regression. Table 3 gives a summary of b-coefficients, their standard errors, the z-statistic (or Wald z-statistic). To calculate the marginal effects at the mean, the *margins* function was used. The proposed model was examined for the presence of highly correlated predictors to assess it for multicollinearity. As a rule of thumb, a VIF value that exceeds 5 indicates a problematic amount of collinearity (Shitikov & Mastitsky, 2017), thus, the multicollinearity of the whole model is within accepted parameters. To test the overall significance of the model, I used the *wald.test* function in R. The chi-squared test statistic of 1635.5, with 9 degrees of freedom is associated with a p-value of 0.00 indicating that the overall effect of the model is statistically significant.

Table 3. Logistic regression results

	Estimates	**Marginal effects**	**Std. Error**	**z value**
(Intercept)	-3.19557 ***		0.12084	-26.445
Behavioural intention	1.27045 ***	0.15	0.08682	17.968
MOOCs use	0.32111 ***	0.04	0.0685	6.391
University use of MOOCs	0.47712 ***	0.06	0.07718	5.184
LD skill	1.01761 ***	0.16	0.14631	1.412
Financial incentives	0.26826 *	0.04	0.12166	-1.338

	Estimates	Marginal effects	Std. Error	z value
Attitude (full replacement)	-0.24296 ***	-0.03	0.15556	-3.992
MOOCs learning experience	0.54995 ***	0.08	0.10276	1.165
5-100 participant	0.51946 ***	0.07	0.13686	2.590
English	0.27536 ***	0.04	0.10805	5.080

Significance codes: 0 '***' 0.001 '**' 0.01 '*'

As Table 3 shows, all variables are statistically significant predictors of MOOC authorship. The coefficient estimates from the logistic regression characterise the relationship between the predictor and the dependent variable on a log-odds scale. In other words, it is a percentage change in the predicted variable when the independent parameter changes by one.

4.3 Model evaluation

To evaluate the model for its predictive power, I estimated the area under the receiver operating characteristic (AUROC). For the model proposed in this study, the AUROC shows the probability that a randomly selected MOOC (or online course) author will have a higher predicted probability of being a MOOC (or online course) author than a randomly selected non-author. An AUROC of 0.77 estimated for the proposed model (Figure 5) means that 77% of the time the model will correctly assign a MOOC (or online course) author status to a randomly selected MOOC (or online course) author.

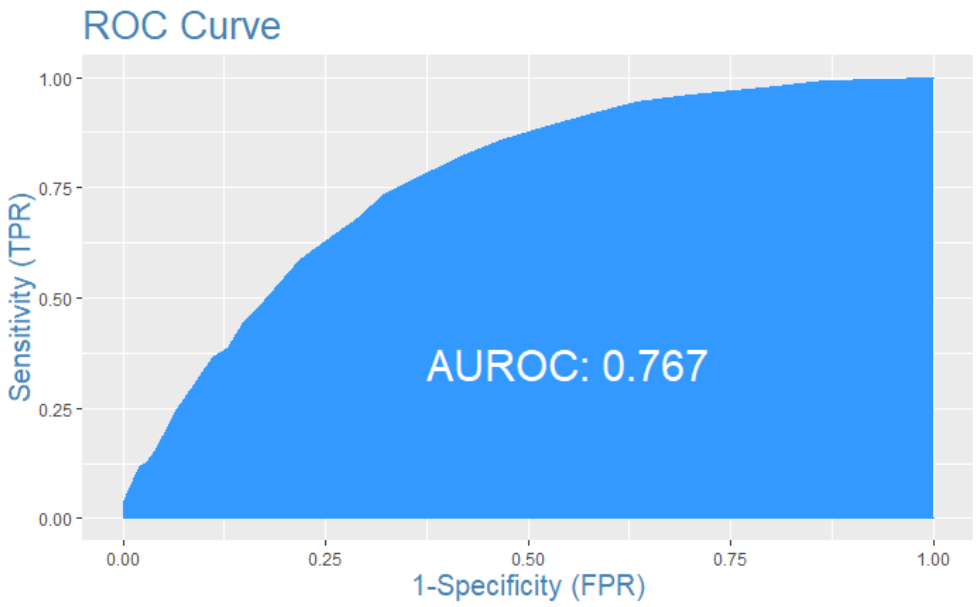

Figure 5. ROC curve and AUROC for the proposed model

4.4 Model interpretation

To interpret the model, the estimated odds ratios were obtained by exponentiating the regression estimates from Table 5 and plotted on Figure 6.

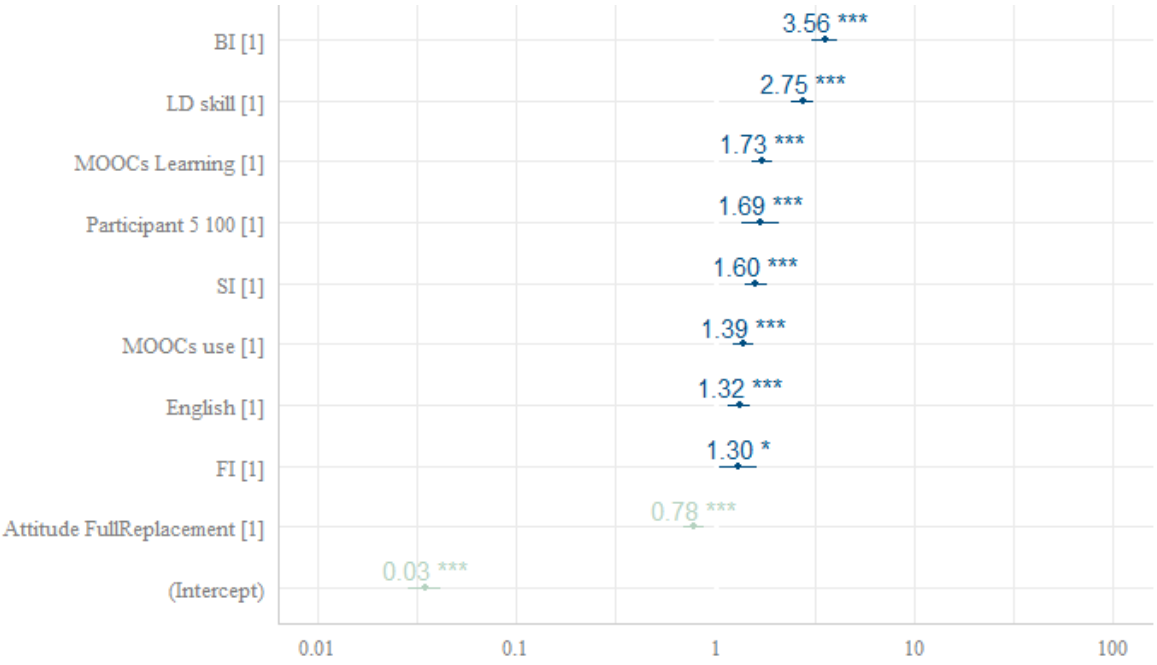

Figure 6. Chances of MOOC authorship

4.4.1 Structural Individual characteristics

Among structural individual factors, intention to design an online course, past experience of MOOC completion, the use of MOOCs in teaching and in preparation for teaching, and the possession of English language skills are all important. This reflects the results reported by Sharma et al. (2017) that experience of work with the learning management system is a significant predictor of its use among educators.

The intention of academics to design their own MOOC (or online course) is a significant determinant of MOOC (or online course) authorship. Academics who expressed an intent to design their own MOOC (or online course) within the next year are almost 4 times likely to be MOOC (or online course) authors. This factor is the most influential variable, which reflects past research on technology adoption (Ajzen, 1991; Venkatesh et al, 2012). Past experience of the successful *completion of a MOOC* and *of using MOOCs* (or online courses) in teaching or preparation for teaching, increases the chances of being a MOOC (or online course) author by 1.73 and 1.38 times, respectively. The study findings also indicate that the effect of *English language skills* is significant. The regression results confirm that academics who reported knowledge of English are 1.32 times more likely to design their own MOOC (or online course). The effect of the *demographic variables* was not confirmed, which contradicts the results of past research (Abu-Shanab & Ababneh, 2015; Sailong, Kumar, & Kerry, 2020; Venkatesh et al., 2003). The absence of demographic factors in the suggested model can be due to the application of the machine learning algorithm, during which redundant or weak variables are removed. However, it is possible that presumably insignificant factors, when combined together, may improve the model. To explore this idea, I added age and gender into the regression model. The results showed that the

inclusion of demographic variables does not influence the effect of other factors on MOOC (or online course) authorship, which is contrary to what is commonly reported in technology adoption research (Eckerdal et al., 2014; Sailong, Kumar, & Kerry, 2020; Venkatesh et al., 2003; León-Urrutia1, Cobos, Dickens, 2018; Sheard et al., 2014). Gender does not have a significant effect on MOOC (or online course) authorship, whereas age does, and it is negative. However, the cross-validation test showed no improvement of the model performance with the inclusion of the age factor.

4.4.2 Cultural Individual characteristics

Two cultural individual factors, namely self-efficacy with regard to possessing online learning design skills and academics' attitude towards full replacement of offline courses by MOOCs, have an impact on MOOC (or online course) authorship.

Self-efficacy about possessing online learning design skills is a significant predictor of MOOC (or online course) authorship. An academic who is confident that they have advanced learning design skills is 2.8 times more likely to be a MOOC (or online course) author, than their colleague who self-reported no or a basic level of skills. The importance of self-efficacy on online learning adoption has been reported by Abdullah and Ward (2016) in the Saudi Arabian context and by Nandwani and Khan (2016) in the Pakistani context. Linking this to the current study, it can be suggested that readiness and preparedness of academics to become a MOOC (or online course) author can be facilitated by providing professional development training to gain advanced online learning design skills. The results also show that the effect of academics' *attitude towards full replacement* of face-to-face courses by MOOCs in core disciplines on online course authorship is significant. Academics who are positive towards integration of MOOCs into the curriculum, with a recognition of earned credits, have a lower probability to be MOOC (or online course) authors than their colleagues. This finding supports the general statement that academics' beliefs influence the decision of educational technology adoption. However, it is surprising that a positive attitude towards MOOCs has the opposite effect on being an author of an online course. For instance, Adov et al. (2020) and Sánchez-Prieto et al. (2017) found a negative relationship between such feelings as doubt or fear and intention to adopt the technology, which is contradictory to what is found in this study. Academics' attitude towards MOOC integration and its effect on their decision to become a MOOC author needs further investigation to propose an explanation for this finding.

4.4.3 Structural Institutional characteristics

The results of the regression show that among variables related to HEI status, only one has a significant impact on MOOC (or online course) authorship. In particular, academics from a *university- participant of the 5-100 project* are 1.7 times more likely to design their own MOOC (or online courses) than their colleagues from other HEIs.

4.4.4 Cultural Institutional characteristics

Among cultural characteristics, *university adoption of MOOCs* and *financial incentives* for the use of educational technology, have a significant impact on MOOC (or online course) authorship. This suggests that favourable conditions for the adoption of educational technologies at a HEI facilitate MOOC authorship among individual academics. For example, financial incentives have been highlighted as an influential factor for technology adoption by Lowenthal, Snelson, and Perkins (2021), Najafi et al. (2015), and Zheng et al. (2016). It was also found that benefits and financial

incentives motivate academics to design and use online courses (Lowenthal, Snelson, & Perkins, 2021; Najafi et al., 2015; Zheng et al., 2016).

5 Conclusion and recommendations

This paper reports the results of an exploratory study on the determinants of MOOC (or online course) authorship among 8,935 Russian HE academics. A wide range of individual and institutional variables were analysed using a machine learning method to explore the most important determinants. Four groups of factors, namely individual cultural, individual structural, institutional cultural and institutional structural, showed their effect on academics' attitudes to MOOC (or online course) authorship.

Regarding individual level factors, the effect of gender was not significant, whereas the age factor showed a negative impact on MOOC (or online course) authorship. Intention to design a MOOC (or online course) is a significant predictor of MOOC (or online course) authorship, which is not surprising and supported by numerous technology adoption studies (Ajzen, 1991; Venkatesh et al, 2012; Snelson, & Perkins, 2021). Past experience of MOOC completion and the use of MOOCs (or online courses) in professional practice are significant and positive predictors of MOOC (or online course) authorship. The effect of skills, e.g. knowledge of English language and confidence in the possession of advanced online learning design skills are additional significant determinants of MOOC (or online course) authorship. A notable finding of this study is a significant and negative effect of the attitude towards full replacement of face-to-face courses by MOOCs in core disciplines on MOOC (or online course) authorship. The nature and the direction of this relationship between two variables is not clear and needs to be further investigated.

The importance of structural factors on an individual level, such as skills and experience, are emphasised in past research. Danchikov et al. (2021) and Efimov and Lapteva (2019) state that a lack of technical skills and academics' unreadiness to navigate educational technologies create barriers for the development of online education. Similarly, Jung and Lee (2019) argued that the adoption of educational technologies depends on the preparedness of academics to use it. Furthermore, support should be offered to academics with no or basic learning design skills. As Novikova et al. (2021) emphasised, different levels of technological competence among educators compromise its adoption nationally. Although some important steps were achieved by the leading universities, the readiness for the rapid, or "shock" (Soltovets et al., 2021, p. 10), digitalisation accelerated by the pandemic was not even across Russia.

Among institutional level factors, participation of a HEI in Project 5-100, and the university's commitment to the introduction of and support for the use of educational technology are significant determinants of MOOC (or online course) authorship. Specifically, the introduction of financial incentives and MOOC adoption in the HEI where an individual academic works, increases the chances of an academic being a MOOC (or online course) author. Referring this finding to the past research, Sukhostavtseva and Rudakov (2021) found that academics have a more favourable attitude towards MOOCs if they were previously available in their HEIs. Furthermore, financial rewards and compensation decrease barriers to online learning design for faculty members (Rotar, 2021; Singleton et al., 2019).

Significant positive relationships were demonstrated between academic's behavioural intention to design a MOOC (or online course) and actual MOOC (or online course) authorship. Thus, it can be argued that MOOC authors have purposive intentions to MOOC design as a means for teaching and learning. The results of this study demonstrate that academics' behavioural intention towards

online course authorship is affected by both cultural and structural factors that exist at individual and institutional levels. The intention to design an online course and self-efficacy about advanced learning design skills are the most significant predictors of MOOC and online course authorship among Russian academics. The highest importance of these two variables was also confirmed by estimating the scores for all predictors in a model. Yet, research has showed that only 11% and 5.6% of academics reported the possession of basic and advanced online learning design skills respectively (Rotar, in press). Literature on the experiences of online learning designers during the pandemic showed that not only a lack of skills, but a limited understanding of the principles and the process of online learning design are common issues (Rotar, 2021). Furthermore, although digitalisation and the development of online education are promoted through the number of digitalisation policies in Russian HE, with an emphasis on the need for academics' professional development; the documents do not offer concrete recommendations for educators involved in online learning design. Based on the results of this study and previous research the following recommendations should be considered when developing professional development programs for academic staff:

1. Academics need to be familiarised with the theoretical underpinnings of online learning design.

Designing an online course is a systematic process that relies on certain knowledge. Educators should not rely on their experience of designing traditional campus-based courses. The theoretical foundations of online learning design derive from such learning theories as behaviourism, cognitivism, constructivism, and social cognitive theory. To select an appropriate theory, educators must understand the characteristics of the course participants (e.g., children, adults, international students) and the purposes of the course in order to choose the best design method and tools.

2. Academics need to be familiarised with methodological design principles.

There are many models and approaches to online learning design and development. For instance, some methodologies focus on the development process itself (e.g., ADDIE, SAM), whereas others help to ensure the logical structure of the course (e.g., 4C/ID, 3C). There are also models that are focused on facilitating student motivation, engagement, and collaborative work (SSDL, ARCS-V model). ADDIE is one of the most commonly used models in online learning design because of the clarity of its design principles. The Agile Learning Design (ALD) model also became popular during the pandemic because of its flexibility and intuitive use. Among the most sophisticated approaches that acknowledge and take into account the complexity of the online learning environment is 4C/ID methodology. Understanding the strengths and limitations of different approaches to online learning design requires professional training.

3. Academics need to explore existing authoring tools.

There are a large number of authoring tools that can assist educators in designing an online course. Among them are My Online Teacher, a content authoring and labelling tool; PEAL, whose objectives are to support online learning designers; EDUCA 2.0 for the creation of adaptive learning materials and to personalise recommendations based on student profiles. In Russia, such tools as iSpring[8] and GetCourse[9] were developed to support learning instructors. In addition, there

[8] https://www.ispring.ru/

[9] https://getcourse.ru/

are platforms for learning designers that can be useful for educators as well. For example, the ASSISTments platform allows designers to create or use pre-built artefacts for learning and WISE (Web-based Inquiry Science Environment) curriculum platform provides users with instructional design support.

National policy documents only set strategic goals for the digitalisation of HE and the development of the online learning industry. Thus, the quality online education and academics' aspiration to contribute to its development should be promoted at the institutional level, including through institutional commitment and professional development support for the staff. Furthermore, the development of academics' digital maturity and the support of their intention to design their own MOOC (or online course) can be enhanced by improving their English language skills, as well as by encouragement of academics to participate in MOOCs as learners.

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