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INVESTIGATION OF UNIVERSITY STUDENTS' PERCEPTIONS OF THEIR EDUCATORS AS ROLE MODELS AND DESIGNERS OF DIGITALIZED CURRICULA

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Abstract: *Higher education graduates need 21st-century skills, both learning skills and competences for working with technology. However, research indicates an insufficient integration of ICTs into teaching and learning. In this paper, we examine students' perception of various technology-based issues: (a) ICT integration within a Slovenian university's learning environment, (b) teachers as role models for ICT use, and (c) the processes of collaboration and creativity as integrative parts featured in learning technologies. We studied beliefs about the contribution of ICT use to teaching and learning as the primary factors influencing ICT integration. A one-way ANOVA revealed that students in teacher education and education studies, as compared to students in other disciplines, perceive their teachers as effective designers of and as role models for ICT integration, although they do not perceive their teachers as leaders in new technology use. Effective leadership in technology innovation and the diversity of instructional design in guided and student-driven learning environments require continual curriculum development.*

Keywords: *higher education, teacher education, information communication technology, educational technology, teacher as a role model, teacher educator.*

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INTRODUCTION

Learning and innovation skills, the 4Cs (creativity, critical thinking, communication, and collaboration), skills for working with technology and in media-driven environments are, along with skills for work and life, integrative parts supporting subject-specific competences in the curriculum for the 21st century (Partnership for 21st-Century Skills [P21], 2012; P21 & American Association of Colleges of Teacher Education, [AACTE], 2010). Technology integration into teaching and learning makes an important contribution to graduates' readiness for the workplace. It differs across sectors and professional disciplines, with the educational sector ranking only 14th of 22 on the Sector Digitalisation Index (Manyika, 2015). Worldwide, 21st-century skills have been applied to national curricula (see, e.g., Siddiq, Gochyyev, & Wilson, 2017). Technology-supported teaching and learning offer the potential for developing skills in critical thinking, problem-solving, and communication (Instefjord & Munthe, 2017), collaboration (Darling-Hammond, 2017; Jääskelä, Häkkinen, & Rasku-Puttonen, 2017), and creativity (Idris & Nor, 2010; Loveless, Burton, & Turvey, 2003; Sang, Valcke, van Braak, & Tondeur, 2010).

Collaboration has been regarded as an integral part of technology-supported student-centered instruction and has widely been discussed (Means & Olson, 1997). The 2017 edition of the *NMC* [New Media Consortium] *Horizon Report* (Adams Becker et al., 2017) highlighted online collaboration as a means for developing 21st-century skills and technology adoption. In a series of recent reports on the essential learning technologies, noted educational consultant Donald Taylor (2017) twice (in 2015 and 2017) ranked collaborative and social learning at the top of his lists. Research in teacher education also has shown collaboration as an essential strategy in technology adoption (Hao & Lee, 2017; Hattie, 2009; Tondeur, van Braak, Siddiq, & Scherer, 2016).

The *NMC Horizon Report* in 2017 revealed inequality in access existed even though online learning resources are available so widely (Adams Becker et al., 2017). In particular, teaching and learning approaches do not apply information communication technologies (ICTs) optimally (Jääskelä et al., 2017). Students increasingly use ICTs in most aspects of their lives and expect universities to address their needs and preferences for ICT use in the institutional learning environment (McGraw-Hill, 2017). Appropriate ICT use significantly affects students' perceptions of the effectiveness of their courses (Venkatesh, Croteau, & Rabah, 2014). Prosser and Trigwell (2000) contended that students' perception of the higher education learning environment should guide teachers' pedagogical decisions because students' perceptions are critical in their academic success. However, Croteau, Venkatesh, Beaudry, and Rabah (2015) identified a gap between teachers' and students' perceptions about the contribution of ICTs to learning, and Hammond (2014) determined a gap between rhetoric and reality in terms of student-centered pedagogy in technology integration. A variety of reasons are reported for this:

- teachers from diverse disciplines in higher education feel they lack the pedagogical competences for technology integration (Conole, Dyke, Oliver, & Seale, 2004);
- the teachers' training in ICTs for the classroom focused more on technical knowledge rather than an integrated approach, thus making it inadequate (Mishra, Koehler, & Kereluik, 2009);
- a lack in dissemination of good practices (Ebert-May et al., 2011);
- a lack of research and training for ICT integration at the tertiary level of education (Instefjord & Munthe, 2017);

- a lack of understanding of higher education teachers' beliefs about technology-integrated teaching and learning (Jääskelä et al., 2017); and
- higher education teachers' negative beliefs about ICT integration for learning and insufficient interventions to transform them (Venkatesh et al., 2014).

Higher education is tasked with preparing graduates for work life and participation in societies undergoing a rapid and sustained diffusion of new technologies, as well as addressing the current digital divide that, in the developed world, refers mainly to skills access and usage access (Van Dijk, 2006). As a result, higher education environments require the capability for fusing the academic and professional spaces with the students' personal technology practices. The rate of integration of new technology depends on social and technical aspects and the users' learning curve. Communication channels and social networks disperse technology innovation and facilitate imitation behaviors that contribute to ICT adoption (Cantono & Silverberg, 2009), with teachers serving as role models and curriculum developers toward this end (Bouckaert & Koos, 2017). Thus, higher education is being required to adopt ICTs within the academic environment and to apply professional and learning technologies within the curricula that offer an authentic learning experience. Such practices also enable students to become early adopters of new technologies in their professional fields. Integrating professional ICTs in curricula accelerates the learning curve of graduates in meeting the ICT requirements of the professional workplace. Differences in ICT implementation in teaching and learning exist within the various higher education professional disciplines (Croteau et al., 2015) and in students' ICT skills (Owens & Lilly, 2017).

It is important to examine differences in ICT-integrated teaching and learning among students of various academic disciplines and to discuss, in particular, the situation for student teachers and students in education studies who, throughout their professional careers, will influence the skills development of younger generations. Since the spread of microcomputers in the 1980s, courses on instructional design and technology increasingly focus on computer-based instruction, influenced by cognitivism and constructivism that facilitated student-centered instruction (Reiser, 2001). Newly qualified teachers need to meet the realities of current classrooms (Kessels & Korthagen, 2001), populated with students living in a digitalized world (Gudmundsdottir & Hatlevik 2018), and to engage teaching pedagogies informed by student-learning approaches and digital practices (Istenič Starčič, Terlevic, Lin, & Lebeničnik 2018). Student teachers increasingly have access to digital resources, but significant diversity in teachers' competences for technology integration is apparent (Gudmundsdottira & Hatlevikb, 2018). Often, a mismatch can be identified between what is expected of newly qualified teachers and their preservice preparation (Instefjord & Munthe, 2017). In this research, we examined whether a difference is apparent in the perceptions of the learning context and the teacher-as-model among students in various higher education academic fields, ranging from education and the arts and humanities to business and law to engineering, math, and ICTs.

Purpose of the Study

The P21 discussions about 21st-century learning and innovation skills, collaboration, creativity, and skills for work with technology (Adams Becker et al., 2017) motivated our research design. This current study examined the academic learning environment in its function in preparing graduates for a working life infused with technology-driven environments. For successful digitalization of academic curricula, students' perceptions and preferences should guide the teacher's pedagogical decisions (Prosser & Trigwell, 2000). Prior research among university students and teachers identified a large gap between students' and teachers' perceptions of the students' use of technology in learning (Dahlstrom, 2015). Earlier research indicates that teachers are insufficient in serving as technology-use role models (Instefjord & Munthe, 2017) but indicates that teachers must assume responsibility as curriculum developers, not just curriculum transmitters (Bouckaert & Koos, 2017).

Based on the reviewed literature, we designed our research objectives to examine students' perception of the microlearning environment. The SQD model (synthesis of qualitative evidence; Tondeur et al., 2012, 2016) of the strategies for technology integration in teacher education informed our study. The SQD model defined factors in three levels: micro-, institutional, and system. In this study, we focused on the microlevel, which, according to Tondeur et al. (2016), consists of instructional design, authentic learning experience, reflection, feedback, collaboration, and the teacher as a role model. We drew from the SQD model in the framework of social cognitive theory, which defines learning as self-reflective and self-regulative in the process of interaction among the person, the behavior in learning situation context, and the environment (Bandura, 1986).

The SQD model (Tondeur et al., 2012, 2016) refers to teachers arranging the learning environment and functioning as role models. In establishing the learning environment, the teacher is responsible for the design of curriculum materials, creating an authentic learning experience, facilitating collaboration among students, and demonstrating technology use. In our study, we examined the students' perceptions of the learning environment by forming five research constructs: teacher's ICT integration into teaching, the requirement of ICT use within the university's learning environment, students' ICT use for collaboration, students' beliefs about ICTs, and the teacher as a role model.

The social cognitive theory informed our study by its discussion of learning complex skills, vicariously by observing the role model's components of action and behavior and "enactively" through actual performance (Bandura, 1971, 1986). According to social cognitive theory, the learning environment is influenced by a complex interplay between personal and sociocultural factors. How students construct their learning environment by selecting learning resources and how they are imposed by formal university curricula are integral parts of this complex interplay between the personal and social contexts. We examined the imposed, university-defined learning environment, known also as a guided environment, and the selected learning environment, which is chosen by students making decisions when creating their personal digital learning environments, a context also known as an unstructured environment (see also Lebeničnik & Istenič Starčič, 2018a).

New technology provides great potential for fusion among academic, professional, and personal spheres, thereby constructing a unique learning environment that combines the selected and imposed environments. In this study, we examined students' perceptions of the imposed and selected environments within the formed research construct of technology integration, the requirements within the university's learning environment, ICTs for collaboration, and the role of the teacher as a model for ICT use (see Figure 1).

Figure 1 represents our research model in concentric circles. In our study, we addressed 4C learning, innovation, and skills for work with technology, together which provide a basis for the 21st-century skills. The outside circle therefore highlights the 21st-century learning and innovation skills—which are creativity, critical thinking, communication, and collaboration—

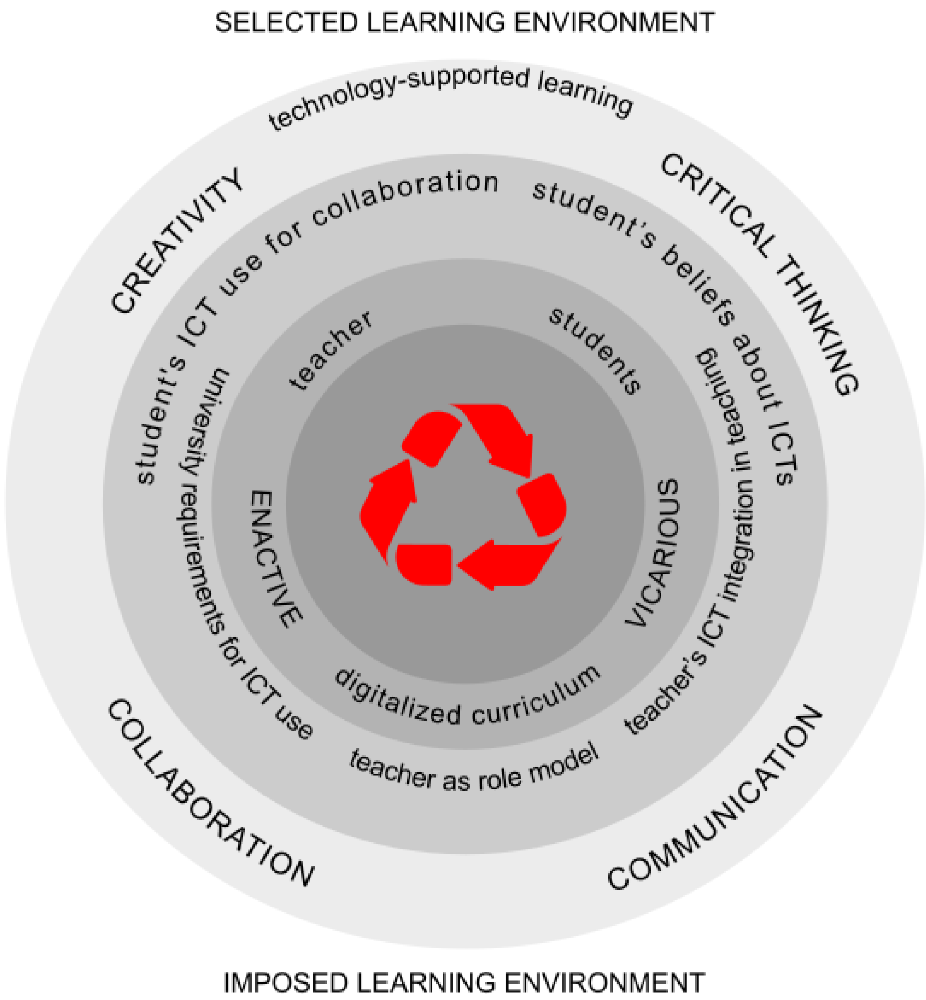

Figure 1. Students' perception of the microlearning environment with reference to enactive and vicarious learning for 21st-Century skills development.

and skills for technology-supported learning. Inside the skills circle is a space with the components affecting students' ICT use, which we designed as research constructs for our study: Students' perception of the Teacher as a Role Model, the University's Requirements for ICT Use, and the Teacher's ICT Integration in Teaching, Students' Beliefs about ICTs, and Students' ICT Use for Collaboration. These are also names of the measurement scales that we designed for our study. In the inner circle, the teacher, student, and digitalized curriculum provide the basis for vicarious and enactive learning. Above the concentric circles, the selected learning environment embodies the student's unstructured environment, whereas beneath the circles is the imposed learning environment focusing more on learning environment guided and provided by the university.

Technology Integration in the Higher Education Learning Environment

Technology integration into teaching and learning in university learning environments makes an important contribution to students' development of competences and skills (Adams Becker et al., 2017; Jääskelä et al., 2017). This requires digital competences to be integrated across curricula at all educational levels. Three possible approaches are applicable for developing competences and skills for ICT use in the professional setting and in the civic and personal spheres of life:

1. The curricular approach involves offering specific courses in computing and information technology.
2. The cross-curricular approach integrates computing and information technology into subject-specific professional-development areas. This integrated approach provides a greater degree of application and sustainability than does the curricular.
3. The most widespread extracurricular practices are informal, self-directed learning approaches that employ online learning resources and collaboration; such informal approaches should be integrated into the formal curriculum (Adams Becker et al., 2017).

Integrating learning technology into the higher education environment, a process that requires a sharp learning curve, has slower adoption and higher rejection by faculty (Underwood & Dillon, 2011). Chandra and Mills (2015) discussed adoption strategies and noted the significant potential for merging ICTs seamlessly into education as well as niche uses of ICTs. Technologies could merge seamlessly with or transform pedagogical practices in learning environment design, within the collaboration between the teacher and students, and among students themselves (Adams Becker et al., 2017).

Digitalizing the higher education curriculum involves reflective practices in planning and designing online learning content and lesson performance (Conole et al., 2004), utilizing artificial intelligence and a variety of sources of data for tracking students' learning processes comprehensively, as well as aligning teaching strategies and feedback that affect students' learning approaches (Gašević & Siemens, 2015). Integrating contemporary technologies and artificial intelligence into education supports insights into the learning process and facilitates reflection on teachers' roles (Istenič Starčič, 2019). This perspective can challenge current beliefs on ICTs in teaching and learning, yet captures the authenticity of ICTs in students' life experiences and professional practices. Authenticity in teaching is achieved by integrating students' authentic existent ICT practices with anticipated professional ICT practices.

Students' perceptions of the higher education learning environment is critical for their selection of learning approaches and consequent academic success; these perceptions also provide essential information for teachers' planning and instructional designs (Prosser & Trigwell, 2000). Digitalized curricula require a diversity of online learning resources, activities, and student skills. However, a divide often is apparent between imposed and selected learning environments. Universities use learning management systems, which tend to be university driven, while students use social media, which are more student driven (Dabbagh & Kitsantas, 2012).

Apart from providing reading packages, students are made aware of the great variety of online resources available to them to enhance their learning; students' can select these autonomously from the course curriculum (Lebeničnik & Istenič Starčič, 2018a, 2018b). Therefore, a university's readiness for and ability to integrate a variety of digital channels to connect the imposed and selected learning environments will support the students' development of 21st-century skills. Online learning resources are beneficial for the flipped classroom model by supplementing the two integral modes of flipped learning: (a) prior classroom preparation and (b) interactive classroom work. Prior to a classroom lecture, online resources are studied at home; then, during classroom work, active learning methods are applied utilizing the online learning resources. Sun, Xie, and Anderman (2018), in their overview of the flipped classroom, highlighted the contribution of Internet-based learning (i.e., online instructional videos and text readings) versus traditional face-to-face instruction. These authors argued for self-directed preclass learning to increase the quality of students’ performance in a flipped classroom and for their overall learning outcomes (Sun et al., 2018). They indicated a need for a transition from the traditional transmissive lectures to supporting self-directed preparation prior to classroom work, which also serves as a basis of knowledge and a form of interactive learning. For both preclass preparation and interactive classroom work, online learning resources could be used as a combination of the selected and imposed learning environments. A virtual extension of the physical classroom also requires university teachers to use technology to support students in developing community among themselves and providing collaborative activities online outside the classroom (Dabbagh & Kitsantas, 2012).

Appropriate instructional or institutional support within a formal curriculum where students bring their own devices (BYOD) also is an important facilitator in the formation of personal learning environments. Such processes connect learning during lectures with learning outside lectures and tutorials (Adams Becker et al., 2017), as well as reduce the intention–behavior gap in learning (Crossler, Long, Loraas, & Trinkle, 2014).

When considering the components of initial teacher education, ICT integration is critical in teaching and learning (Drent & Meelissan, 2008). Therefore, teacher education should provide authentic experiences (Reeves, Herrington, & Oliver, 2002; Tondeur et al., 2016) that expose students to a variety of teaching strategies and classroom activities (Hattie, 2009), a diversity of outcomes, and seamless integration into assessment (Reeves et al., 2002). Authentic learning experiences also require an integrated approach connecting technological, pedagogical, and content knowledge (Mishra et al., 2009) and connect the learner to the social context where the technology is applied (Istenič Starčič & Turk, 2016). As a result, in line with Tondeur’s SQD model (Tondeur et al., 2012, 2016), influencing factors at the microlevel are integrated into the contexts at the institutional and system levels.

Teacher-Educator as a Role Model

Students’ observation of their teacher’s behavior during the learning process is an essential component of their education (Kelcherman, 2009). Concerning the inclusion of ICTs in classroom teaching, how much a teacher’s behavior influences students’ use of technologies for learning is uncertain. Based on a survey among preservice teachers in Flanders, Belgium, Tondeur et al. (2016) stressed that the teacher-educator as a role model in technology use is critical, as their research suggested teacher-educators seem not to provide sufficient modeling. Lai (2015) mapped teachers’ behavior in technology integration, assessing also the teacher’s influence on students’ technology use outside the classroom. He highlighted a combination of roles the teacher plays on three levels: affection (i.e., encouragement and enhancing awareness for technology use), capacity (i.e., use recommendations and tips), and behavioral support (i.e., the teacher serves as a model for technology use). Thus the teachers’ role in technology integration needs close attention. Teacher-educators perform many roles, and in technology integration, we highlight two: as a role model in ICT use with actual use behavior and as curriculum developer offering experiences concerning a digitalized curriculum (Bouckaert & Koos, 2017). Katyal and Evers (2004) confirmed the two levels of teachers’ activity explicitly through instructional practice and implicitly by role modeling (see also Lai, 2015). Because technology integration requires addressing technological, pedagogical, and content knowledge (Mishra et al., 2009), role modeling requires actual use of technology in teaching and curriculum design (Tondeur et al., 2016). Student learning from observing role models or from the implicit modeling provided through the design of the curriculum is essential in preparing for technology integration (Milrad, Spector, & Davidsen, 2002) in professional contexts. Modeling also provides one of the most important sources for transmitting values and attitudes (Bandura, 1986). Teachers should introduce new technological solutions by modeling their professional use of ICTs, thus acting as role models and facilitating observational learning. Vicarious learning occurs through students observing actual performance or by symbolic models in the absence of overt performance. Such processes enhance learning better than if students have to perform every action one at a time to learn it.

The rapidly changing social context concerning technology developments and younger generations increasingly adopting new technologies into their day-to-day lives require leadership by teachers in the field. Teacher-educators increasingly are responsible for integrating technological innovations into the initial preservice curriculum development and for modeling technology integration through continual curriculum development (Bouckaert & Koos, 2017; Tondeur et al., 2016), providing authentic experiences through applying a set of strategies (Tondeur et al., 2016) that support changes at the levels of attitudes and behavior (Instefjord & Munthe, 2017). Based on Bandura's (1986) research, teacher-educators transmit values and attitudes through modeling. Thus, teachers' actions could directly inhibit or facilitate students' actions, while the teachers advance learning through modeling, that is, students develop new behaviors based on observation of their teachers' modeling (Schunk, 2012, pp. 127). By observing their teachers' interactions with technology and participating in digitalized curriculum learning activities designed by their teachers, student teachers acquire experiences in technology use that influence the development of attitudes, beliefs, and motivation for using ICTs during their initial education, which in turn encourages their future pedagogical technology integration.

Collaborative and Creative Aspects of Learning and Students' Beliefs About ICT Use

Technology-supported learning environments facilitate critical thinking, collaboration skills (Jääskelä et al., 2017), and creativity (Idris & Nor, 2010; Loveless et al., 2003; Sang et al., 2010). Such learning environments also could reduce the divide between academic and professional behaviors in real-life contexts (Istenič Starčič et al., 2018).

Collaboration is among the main affordances of ICTs (Conole & Dyke, 2004) and is essential in student-centered technology-supported learning (Means & Olson, 1997). Information sharing and networking form the basis for the information society and the networked society. Computer-supported collaborative learning, which rose in 1980s, continues to be a main trend in higher education (Adams Becker et al., 2017). Thus, the higher education classroom extends outward from the physical classroom through the spread of online resources, most of which are predominantly collaborative in nature.

Karakaya and Demirkan (2015) and Muldner and Burleson (2015) examined these collaborative digital environments as means for enhancing creativity. Creativity in learning is augmented when students are curious and excited (Torrence & Goff, 1990), and technology-supported learning increases the level of students' creativity in learning (Sang et al., 2010). Idris and Nor (2010) examined ICT integration into learning with reference to excitement, motivation, and curiosity, which enhance learning. Flexible environments, facilitated by the affordances of ICTs, also support creativity (Davies et al., 2013).

Darling-Hammond (2017) discussed teacher preparation in a 21st-century curriculum based on collaboration and interactive computer technology for meaningful learning. In teacher education and education studies, group work and collaboration with peers are essential when preparing them for technology integration in teaching (Hao & Lee, 2017: Hattie, 2009; Tondeur et al., 2016), as well as providing opportunities for engagement and reflection (Tondeur et al., 2016).

Teaching and learning should engage students in authentic technology practices such as social network practices, which parallel students' authentic social practices (Istenič Starčič et al., 2018). Collaboration and online sharing behaviors also support vicarious learning (Bandura, 1986; Schunk, 2012), which could contribute to technology adoption (Adams Becker et al., 2017) into other spheres of their lives and enhance their beliefs about technology integrated into learning and teaching. The use of social collaboration practices among peers and other groups facilitates the formation of beliefs, which in turn, guides behavior (Ajzen, 2001).

Regarding meaningful learning, we also examined the relationship between beliefs and technology use, focusing on collaborative learning as an integral part of student-centered learning (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012; Means & Olson, 1997). Ertmer et al. (2012) concluded that beliefs regarding student-centered learning correspond with collaborative technology-supported learning.

Beliefs are regarded as the most influential internal factors of behavior (Ertmer et al., 2012), influencing, in the case of educational behavior, the probability of pedagogical change (Hao & Lee, 2017). Sang et al. (2010) established that attitudes toward technology in education among student teachers are the strongest predictor of future use. Preservice education could impact significantly a student's internal factors (Paratore, O'Brien, Jiménez, Salinas, & Ly, 2016) and is therefore critical for developing future teachers' beliefs about technology integration in teaching and learning (Drent & Meelissan, 2008). Beliefs are the mediating factor that build the framework of values embedded within the learning process and skills development. Whether or not preservice teachers integrate the value of ICTs into their beliefs will influence their prospective technology integration (Chen, 2010).

Research has demonstrated that, among university students, beliefs toward ICT use in learning is one of the main predictors for technology use (Lai, Wang, & Lei, 2012). Thus, beliefs are strong influencing factors in relation to one's attitudes toward (Ajzen, 2001), perceived capabilities of (Bandura, 1986), and perceived characteristics of ICT in learning. Beliefs predict behavior as predisposition to respond favorably or unfavorably toward an object or objective (Ajzen, 1988). In related studies, Sang et al. (2010) identified several key research-instrument scale items for beliefs toward ICT use in education: improving learning performance, efficiency, individualization and differentiation in learning, and the level of creativity in students. Van Braak and Tearle (2007) identified three more: (a) observability, referring to ICT use allowing teachers and peers to see outcomes; (b) specificity, referring to ICTs supporting tasks that otherwise are not possible; and (c) flexibility with ICTs, providing learning activities performed with greater adaptability. In related studies, outcomes of beliefs regarding ICTs in education include ICT usage, motives toward accessing information, increased interaction, and networking and collaboration (LaRose & Eastin, 2004; Senkbeil & Ihme, 2017).

Hypotheses

As noted earlier, a digital index report on the differences across sectors and professional disciplines indicated a low ranking for the educational sector (Manyika, 2015). In higher education, a Canadian study (Croteau et al., 2015) reported disciplinary differences in ICT integration in teaching and learning. Therefore, we wanted to examine whether differences exist among several professional disciplines, ranging from education and arts and humanities to business and law and to engineering and math and ICTs. In our research, the focus is on investigating any differences between student-teachers and students in the education studies and students in other disciplines. The following hypotheses guided our research:

H1: A difference can be identified among the disciplines regarding students' perceptions of technology integration in teaching, corresponding to the frequency of ICT use by teachers.

H2: Among disciplines, differences will be apparent in students' perceptions of the technology integration requirements of the university learning environment.

H3: There is a difference among disciplines in students' perceptions of the teacher as a role model in technology integration.

H4: A difference exists among disciplines in students' perceptions of their ICT use for collaboration.

H5: Students' beliefs about ICT use will differ among the disciplines.

METHOD

Research Design, Participants, and Procedures

We designed a survey as part of a study, titled "The Online Learning Resources in Higher Education." The University of Ljubljana, Slovenia, invited us to conduct this survey as part of their "The Integration of Information and Communication Technology in Higher Education Pedagogical Process" project. For this study we developed scales to examine students' views of "the teacher as a role model for ICT use," "university requirements for ICT use," and "teacher's ICT integration in teaching."

This exploratory study allowed us to seek out possible disciplinary differences that have not been investigated extensively. The objective of our research was to identify issues that could be addressed in the future. We conducted the survey study at one university in Slovenia; however, it is the largest among four Slovene universities, with approximately 40,000 students coming from all parts of Slovenia. The university enrolls 67.3% of the Slovene student population (Republic of Slovenia, Ministry of Education, Science, and Sport, 2018).

We conducted the survey in June and July 2017, during the examination period, so we anticipated a low response rate. The university's vice-rector forwarded an e-mail from the research team inviting students to participate in an online survey on ICT use. The invitation was sent to all students enrolled that academic year, with 2,325 taking part. However, only 1,359 students provided usable responses by completing the whole survey. Completion required answering questions about technology integration in teaching, requirements for technology integration in the learning environment, and the teacher as a role model. Tables 1 and 2 present the distribution of respondents (N = 1,359).

Table 1. Survey Participant Distribution by Sex and Study Level.

		Total	
		f	%
Sex	Female	898	66.1
	Male	461	33.9
Study level	1st Bologna cycle	829	61.0
	2nd Bologna cycle	474	34.9
	3rd Bologna cycle	56	4.1
	Total	1,359	100.00

Note. 1st Bologna cycle = Bachelor program; 2nd Bologna cycle = Master program; 3rd Bologna cycle = Doctoral program.

Table 2. Survey Participant Distribution by Study Field.

Study field, KLASIUS-P* ACRONYM		f	%	f **Total student population in Slovenia
TEES	Teacher Education and Education Studies	154	11.3	7,521
AH	Arts and Humanities	206	15.2	7,299
SSBAL	Social sciences, Business, administration and law	273	20.1	22,130
NSMI	Natural sciences, mathematics, and ICTs	343	25.2	8,030
EMC	Engineering, manufacturing and construction	213	15.7	14,182
HW	Health and welfare	168	12.4	9,786
	Total	1,359	100.0	68,948

Note. *The KLASIUS-P classification is based on the similarities of subject-specific characteristics and is used for statistical and administrative purposes (Statistical Office of Republic of Slovenia, 2017). **Data about total student population in Slovenia in 2016/17 by study fields is based on data from the Statistical Office of the Republic of Slovenia (2017).

Data Analysis

We calculated the descriptive statistics for numeric variables (e.g., mean, standard deviation). Data were screened for the assumption of normality of distribution using the Shapiro-Wilk test and histograms and for the assumption of homogeneity of variance using Leven's test. We conducted a one-way analysis of variance (ANOVA) to identify whether differences between academic disciplines existed. If a one-way ANOVA was statistically significant, we additionally performed a post hoc test of multiple comparisons to establish between which study programs the differences exist. When the assumption of normality of distribution and homogeneity of variance were confirmed, and statistical significance established ($p < 0.05$), we applied the Tukey post hoc test of multiple comparisons. When the Shapiro-Wilk test and histograms identified a violation of assumptions of normality and the Leven test identified nonequal variances, we applied a nonparametric test, the Kruskal-Wallis test by ranks. In cases of significant difference between study programs identified by the Kruskal-Wallis test ($p < 0.05$), we additionally performed pairwise comparisons with Bonferroni corrections for multiple comparisons.

For estimating effect size we calculated Cohen's d using the means and standard deviations of each pair of groups between which significant differences were found in the post hoc testing. Effect sizes were interpreted as small ($d \geq .2$), medium ($d \geq .5$) and large ($d \geq .8$; Cohen, 1988). We also performed principal axis factoring (PAF) to establish clear, reliable factors for each category of variables and discover the latent structure of measured constructs.

Measures

Based on the SQD model (Tondeur et al., 2012, 2016) and social cognitive theory placing special emphasize on vicarious and enactive learning, we developed the following scales: Teacher as a Role Model, Teacher's ICT Integration in Teaching, and University's Requirements for ICT Use. We designed the items on the scales Teacher as a Role Model and Teacher's ICT Integration in Teaching based on Lai (2015). The Teacher's ICT Integration in Teaching referred to how often the teacher used ICTs. We drew on Lai (2015) and Dahlstrom et al. (2015) to design the items on the scale University's Requirements for ICT Use.

We performed PAF (Table 3) for the scales Teacher as a Role Model, Teacher's ICT Integration in Teaching, and University's Requirements for ICT Use. To measure frequency for Teacher's ICT Integration in Teaching and University's Requirements for ICT Use, we used an ordinal five-point Likert scale (1–*Never*, to 5–*Very often*). The ordinal five-point Likert measure (1–*Completely disagree*, to 5–*Completely agree*) was set for the Teacher as a Role Model scale.

Seven items with cross loadings were dropped (Table 3). Items with factor loadings above .350 were included (Clark & Watson, 1995) and were between .802 and .350. The rotation method was Varimax with Kaiser Normalization and converged in five iterations. We inspected scree plots for inclusion of factors in final solutions. The KMO value was 0.873, and Bartlett's sphericity test was significant ($p < 0.001$). PAF revealed three factors (Table 3). The first factor, Students' perception of Teacher as a Role Model, explained 20.5% of the variance, and the internal consistency was at a high level (Cronbach's alpha = 0.896). The second factor, Students' Perception of the University's Requirements for ICT use, explained 11.9 % of the variance and the internal consistency was at a high level (Cronbach's alpha = 0.742). The third factor, Students' Perception of Teacher's ICT integration in teaching, explained 10.1 % of the variance and the internal consistency was questionable (Cronbach's alpha = 0.609). We kept the last factor in the analysis, due to its contents, even if its alpha is questionable.

To examine collaborative and creative aspects of learning and students' beliefs about ICT use, two scales were used, Student's Beliefs About ICTs and Students' ICT Use. We designed the scale Student's Beliefs about ICTs with a five-point Likert scale (1–*Completely disagree*, to 5–*Completely agree*) in the framework of social cognitive theory and based on items from scales designed by Dahlstrom (2015), McGraw-Hill (2017), Hakkarainen et al. (2000), Lai et al. (2012),

Table 3. Factorial Structure of Teacher as a Role Model, University's Requirements for ICT Use, Teacher's ICT Integration in Teaching.

Factor	Items	1	2	3
Teacher as a Role Model	I look to faculty for how to resolve problems that may occur during ICT use.	**.802**	.037	.119
	Faculty use innovative technological solutions.	**.757**	.110	.234
	Faculty show enthusiasm for using technological solutions.	**.732**	.094	.182
	Faculty are successful in using ICT for teaching.	**.709**	.100	.214
	Faculty are at least as competent as I am in using ICTs.	**.674**	.033	.127
University's Requirements for ICT Use	I am required to use ICTs for data analysis.	.169	**.738**	.213
	I am required to use ICTs for computer-supported collaborative learning.	.123	**.719**	.221
	I am required to use ICTs for independent study.	.192	**.609**	.260
	I am required to use ICTs for which I do not get adequate training.	-.065	**.387**	-.003
Teacher's ICT Integration in Teaching	ICT use for outside classroom lectures and tutorials for students' activities (e.g., computer-supported collaborative learning).	.078	.098	**.599**
	ICT use for feedback and assessment.	.112	.056	**.511**
	ICT use during classroom lectures and tutorials for students' activities (e. g., computer-supported collaborative learning).	.096	.149	**.452**
	ICT use outside classroom lectures for learning content prior to organized class lectures.	.164	.096	**.373**
	Enhancing bring your own device (BYOD) during organized classroom activities.	.134	.096	**.350**
	Cronbach's alpha	0.896	0.742	0.609
	% of variance	20.51	11.90	10.10
	Number of items	5	4	5

Note. Extraction method: Principal axis factoring; Rotation method: Varimax with Kaiser Normalization. Rotation converged in five iterations.

Sang et al. (2010), van Braak & Tearle (2007), LaRose & Eastin (2004); Senkbeil & Ihme, (2017). The scale Students' ICT Use, with an ordinal five-point Likert scale measuring frequency (1–*Never*, to 5–*Very often*), drew on the work of Laurillard's classification (2002), Churchill (2007), and Dabbagh and Reo (2011).

We performed PAF (Table 4) for the two scales, Student's Beliefs about ICTs and Students' ICT Use. Eight items with cross loadings were dropped. Items with factor loadings above 0.35 were included (Clark & Watson, 1995) and were between .703 and .350. Rotation method was Varimax with Kaiser Normalization and converged in 11 iterations. We inspected scree plots for inclusion of factors in final solutions. The KMO value was 0.953, and Bartlett's sphericity test was significant ($p < 0.001$).

PAF revealed three factors (see Table 4). The first factor, Students' ICT use, explained 13.8% of the variance, and the internal consistency was at a good level (Cronbach's alpha = 0.896). The second factor, Student's Beliefs about ICTs, explained 13.5 % of the variance, and the internal consistency was at a high level (Cronbach's alpha = 0.900). The third factor, ICT use for collaboration, explained 10.3 % of the variance, and the internal consistency was at a high level (Cronbach's alpha = 0.831).

Table 4. Factorial Structure of Student's ICT Use, Student's Beliefs about ICT and Student's ICT Use for Collaboration.

Factor	Items	1	2	3
Student's ICT use	I watch educational videos (e.g., video lectures).	**.635**	.220	.088
	I use online learning content designed by fellow users of social network sites.	**.613**	.297	.151
	I use online simulations.	**.590**	.232	.188
	I use online tutorials.	**.566**	.232	.167
	I visit Web portals with educational content from my study field.	**.565**	.181	.284
	I use Web encyclopedias.	**.563**	.221	.100
	I read weblogs with content from my study area (e.g., blogs, social networks).	**.532**	.229	.383
	I bookmark websites with educational content from my study field (e.g., pinterest.com, bookmark in browsers).	**.501**	.138	.276
	I network on social media (e.g., following or adding people, subscribing to channels) with the intention to get access to educational content from my study field.	**.488**	.167	.368
	I subscribe to digital newsletters and notifications from websites with educational content.	**.475**	.054	.403
	I use social bookmarking sites (e.g., reddit.com, pinterest.com, del.icio.us) to learn from other users about relevant online resources from my study field.	**.456**	.160	.286
	I use information generated from communication between online users (e.g., forums, Q&A websites, comments on websites) while learning.	**.446**	.179	.393
	I use online databases with scientific and professional articles while learning.	**.437**	.115	.115
	I use online pictures (e.g., mind maps, graphics) while learning.	**.432**	.289	.202
	I use Web search engines while learning.	**.418**	.322	.039
	I use Web applications for knowledge self-assessment (e.g., quizzes).	**.356**	.162	.306
	I use online dictionaries/translation applications.	**.350**	.144	.148
Student's beliefs about ICTs	Using ICTs for learning allows me to customize the learning process to my needs.	.231	**.703**	.098
	Learning with ICTs is more fun than traditional learning.	.200	**.669**	.102
	I have better grades because of use of ICTs for learning.	.197	**.636**	.140
	ICT use allows me to be more creative in learning.	.230	**.630**	.117
	When I use ICTs, I am more curious during learning.	.246	**.613**	.096
	ICT use supports me in better collaboration with others.	.090	**.565**	.316
	ICTs allows me to learn anywhere.	.233	**.562**	.087
	Others (e.g., professors, colleagues) can see positive results when I use ICTs for learning.	.151	**.527**	.276
	Information gathered online is better than information from other sources.	.182	**.524**	.181
	On the Web, I have access to learning information I could not get anywhere else.	.220	**.518**	.021
	ICT use offers me a feeling of belonging to a group.	-.051	**.506**	.429
	Using the Web for learning, I can get access to more information than with any other source (e.g., books, professors).	.282	**.495**	.055
	Using ICTs for learning allows me to get to know other people better.	.145	**.466**	.356
	Using ICTs allows me better personal interaction with academic staff.	.395	**.444**	.075
	On the Web, I can better follow trends in my study field.	.395	**.444**	.075

Table 4. Factorial Structure of Student's ICT use, Student's beliefs about ICT and Student's ICT use for collaboration (continued)

Student's ICT use for collaboration	I seek help online if I have a problem.	.149	.148	**.632**
	I share information related to my courses on social media sites.	.307	.042	**.584**
	I participate in social network sites discussions from my study fields.	.279	.106	**.539**
	I follow the educational content suggested by computer recommendation system (e.g., on multimedia platforms, social networks, online news).	.440	.240	**.506**
	I participate actively in online communities in my study field where I know the majority of participants.	.051	.187	**.499**
	I use synchronous communication e-tools for communicating with other students while learning (e.g., Skype, Facebook Messages, gTalk, Viber).	.115	.226	**.461**
	I post blogs on the Web with content from my study field (e.g., long posts on social networks, a stand-alone blog, use of blog platforms, online weblog writing).	.357	.012	**.454**
	I co-create documents for my course learning (e.g., Google docs, Wiki).	.358	.144	**.434**
	I use news aggregators (RSS feed, e.g., feedly.com).	.328	.085	**.426**
	I share my own files for learning with others (e.g., Google Drive, Dropbox).	.273	.167	**.420**
	Cronbach's alpha	0.896	0.900	0.831
	% of variance	13.87	13.50	10.30
	Number of items	16	15	10

Note. Extraction method: principal axis factoring; Rotation method: Varimax with Kaiser Normalization. Rotation converged in 11 iterations.

RESULTS

A Difference Among Disciplines in Students' Perception of Teacher's ICT Integration in Teaching Corresponding to the Frequency of ICT Use by Teachers

Students assessed the frequency of occurrence of items in teaching on an interval scale (1–*Never*, to 5–*Very frequently*). Statistically significant differences were identified between the various disciplines in three items; the data partly confirmed H1. Post hoc tests identified pairwise difference with small effect size. No statistically significant difference was found in two items (Table 5).

Kruskal-Wallis testing identified significant differences between disciplines for ICT use for classroom activities, $\chi^2(5) = 19.150$, $p = .002$, ICT use for learning content prior to lectures, $\chi^2(5) = 17.938$, $p = 0.00$, and feedback and assessment, $\chi^2(5) = 13.051$, $p = 0.023$.

Compared to those in other disciplines, TEES students' means were lowest only in two items of five. The lowest were in BYOD ($M = 2.52$, $SD = 1.08$) and feedback and assessment ($M = 2.56$, $SD = 1.03$). The balance of the items were ICT use outside classroom lectures and tutorials for student activities ($M = 2.81$, $SD = 1.13$) and for learning content prior to lectures ($M = 2.84$, $SD = 1.11$). TEES students had high means relative to others in ICT use for activities during lectures ($M = 3.25$, $SD = 1.98$), differing significantly from students in HW ($M = 2.77$, $SD = 1.02$).

Table 5. ANOVA and Post Hoc Test Results for Teacher's ICT Integration in Teaching Corresponding to the Frequency of ICT Use by Teachers.

Items	**Study field–KLASIUS-P**	***M***	***SD***	**Between-group difference (Post hoc test /pairwise comparison)**
UT1. Enhancing bring your own device (BYOD) during classroom activities.	TEES	2.52	1.08	n.s.
	AH	3.06	1.27	
	SSBAL	2.79	0.95	
F(5) = 9.699, ***p* = 0.084**	NSMI	2.86	1.11	
	EMC	2.80	1.10	
	HW	2.53	0.86	
	Total	2.76	1.07	
UT2. ICT use during classroom lectures and tutorials for students' activities (e.g., computer-supported collaborative learning).	TEES	3.25	0.98	HW < TEES (***p* = 0.013**, *d* = 0.47), HW < SSBAL (***p* = 0.002**, *d* = 0.44)
	AH	3.00	1.00	
	SSBAL	3.24	1.08	
	NSMI	3.03	1.15	
χ^2 = 19.150, ***p* = 0.002**	EMC	2.99	1.06	
	HW	2.77	1.02	
	Total	3.04	1.07	
UT3. ICT use outside classroom lectures and tutorials for students'' activities (e.g., computer-supported collaborative learning).	TEES	2.81	1.13	n.s
	AH	2.96	1.04	
	SSBAL	3.05	1.12	
	NSMI	3.07	1.17	
F(5) = 7.890, *p* = 0.162	EMC	3.08	1.05	
	HW	2.72	1.06	
	Total	2.97	1.10	
UT4. ICT use outside classroom lectures for learning content prior to organized class lectures.	TEES	2.84	1.11	HW < SSBAL (***p* = 0.006**, *d* = 0.47), HW < ECM (***p* = 0.047**, *d* = 0.46)
	AH	3.11	1.00	
	SSBAL	3.27	1.14	
χ^2 = 17.938, ***p* = 0.003**	NSMI	3.10	1.12	
	EMC	3.25	1.11	
	HW	2.76	1.00	
	Total	3.09	1.09	
UT5. ICT use for feedback and assessment.	TEES	2.56	1.03	n.s
	AH	2.69	1.17	
χ^2 = 13.051, ***p* = 0.023**	SSBAL	2.93	1.21	
	NSMI	3.07	1.20	
	EMC	3.01	1.09	n.s
	HW	2.68	0.89	
	Total	2.89	1.13	

Note. UT–University teaching; TEES–Teacher Education and Education Studies; AH–Arts and Humanities; SSBAL–Social sciences, Business, administration and law; NSMI–Natural sciences, mathematics, and ICTs; EMC–Engineering, manufacturing and construction; HW–Health and welfare.
$p < .05$ is in bold; n.s.–nonsignificant,

Post hoc testing indicated HW students (*M* = 2.77, *SD* = 1.02) use ICTs less frequently during classroom lectures and as tutorials for student activities (e.g., computer-supported collaborative learning) than do TEES (*M* = 3.25, *SD* = 1.98) and SSBAL (*M* = 3.24, *SD* = 1.08) students. ICT use outside classroom lectures for learning content prior to organized class lectures was significantly less frequent for HW students (*M* = 2.76, *SD* = 1.00) than for SSBAL (*M* = 3.27, *SD* = 1.14) and EMC (*M* = 3.25, *SD* = 1.11) students.

There was a significant difference in ICT use for feedback and assessment; however, post hoc testing did not identify significant differences between groups. No significant differences were found in BYOD and ICT use outside classroom lectures and tutorials for student activities.

A Difference Among Disciplines in Students' Perception of University's Requirements for ICT Use

Students assessed the frequency of items in teaching and learning on an interval scale (1–*Never*, to 5–*Very frequently*). A statistically significant difference between the disciplines is apparent in all four scale items, thereby confirming H2 (Table 6). Post hoc tests identifying pairwise difference with small effect size in almost all cases. The pairwise difference with medium effect size was identified in the "I am required to use ICTs for data analysis" between AH and SSBAL (*d* = 0.64) and between AH and NSMI (*d* = 0.69).

TEES students had higher means (*M* = 3.18, *SD* = 1.25) for the item "I am required to use ICT for independent study," whereas we found a significant difference between groups, $\chi^2(5) = 16.302$, $p = 0.006$. Post hoc testing indicated that AH students (*M* = 2.77, *SD* = 1.23) use ICTs significantly less often for independent study than do students of TEES (*M* = 3.18, *SD* = 1.25) and NSMI (*M* = 3.14, *SD* = 1.20).

TEES students also had higher means (*M* = 2.17, *SD* = 1.05) for "I am required to use ICT for which I do not get adequate training," and there was a significant difference between groups, $\chi^2(5) = 21.142$, $p = 0.001$. Post hoc testing indicated AH students (*M* = 1.88, *SD* = 1.11) are required to use technology for which they do not get adequate training significantly less frequently than are students of TEES (*M* = 2.17, *SD* = 1.05) and EMC (*M* = 2.21, *SD* = 1.13).

TEES students (*M* = 2.78, *SD* = 1.19) also had the second highest mean in "I am required to use ICT for computer supported collaborative learning;" a significant difference between groups also was found, $\chi^2(5) = 57.192$, $p = 0.000$. Post hoc testing indicated AH students (*M* = 2.15, *SD* = 1.10) use technology for collaborative learning less frequently than do students of TEES (*M* = 2.78, *SD* = 1.19), EMC (*M* = 2.39, *SD* = 1.15), HW (*M* = 2.60, *SD* = 1.19), NSMI (*M* = 2.66, *SD* = 1.23), and SSBAL (*M* = 2.93, *SD* = 1.25). Post hoc testing also indicated that EMC students (*M* = 2.39, *SD* = 1.15) use technology for collaborative learning less frequently than do students of TEES (*M* = 2.78, *SD* = 1.19) and SSBAL (*M* = 2.93, *SD* = 1.25).

Post hoc testing indicated a significant difference for "I am required to use ICT for data analysis," χ^2 (5) = 71.728 $p = 0.000$. Post hoc testing indicated AH students (*M* = 2.49, *SD* = 1.19) use data analysis less frequently than do students of TEES (*M* = 3.03, *SD* = 1.11), EMC (*M* = 2.89, *SD* = 1.19), HW (*M* = 2.95, *SD* = 1.14), SSBAL (*M* = 3.26, *SD* = 1.21), NSMI (*M* = 3.32, *SD* = 1.21).

Post hoc testing indicated EMC students (*M* = 2.89, *SD* = 1.19) are using data analysis less frequently than are students of SSBAL (*M* = 3.26, *SD* = 1.21) and NSMI (*M* = 3.32, *SD* = 1.21). Post hoc testing also revealed that HW students (*M* = 2.95, *SD* = 1.14) use data analysis less frequently than do NSMI (*M* = 3.32, *SD* = 1.21) students.

Table 6. ANOVA and Post Hoc Test Results for in Students' Perception of University's Requirements for ICT Use.

Items	Study field - KLASIUS-P	*M*	*SD*	Between-group difference (Post hoc test /pairwise comparison)
UR1. I am required to use ICTs for which I do not get adequate training.	TEES	2.17	1.05	AH < TEES (***p* = 0.018**, *d* = 0.26),
	AH	1.88	1.11	AH < ECM (***p* = 0.005**, *d* = 0.29)
	SSBAL	1.93	1.02	
χ^2 = 21.142, ***p* = 0.001**	NSMI	2.04	1.07	
	EMC	2.21	1.13	
	HW	1.88	0.96	
	Total	2.01	1.06	
UR2. I am required to use ICTs for computer-supported collaborative learning.	TEES	2.78	1.19	AH < TEES (***p* = 0.001**, *d* = 0.02)
	AH	2.15	1.10	AH < HW (***p* = 0.005**, *d* = 0.21)
	SSBAL	2.93	1.25	AH < NSMI (***p* = 0.001**, *d* = 0.23)
	NSMI	2.66	1.23	AH < SSBAL (***p* = 0.001**, *d* = 0.36)
χ^2 = 57.192, ***p* = 0.000**	EMC	2.39	1.15	ECM < TEES (***p* = 0.044**, *d* = 0.33)
	HW	2.60	1.19	ECM < SSBAL (***p* = 0.001**, *d* = 0.45)
	Total	2.59	1.21	
UR3. I am required to use ICTs for data analysis.	TEES	3.03	1.11	AH < TEES (***p* = 0.001**, *d* = 0.46)
	AH	2.49	1.19	AH < EMC (***p* = 0.008**, *d* = 0.33)
	SSBAL	3.26	1.21	AH < HW (***p* = 0.006**, *d* = 0.39)
χ^2 = 71.728, ***p* = 0.000**	NSMI	3.32	1.21	AH < SSBAL (***p* = 0.001**, *d* = 0.64)
	EMC	2.89	1.19	AH < NSMI (***p* = 0.001**, *d* = 0.69)
	HW	2.95	1.14	EMC < SSBAL (*p* **= 0.019**, *d* = 0.31)
	Total	3.04	1.22	EMC < NSMI (*p* **= 0.002**, *d* = 0.35)
				HW < NSMI (***p* = 0.018**, *d* = 0.31)
UR4. I am required to use ICTs for independent study.	TEES	3.18	1.25	AH < TEES (***p* = 0.041**, *d* = 0.33)
	AH	2.77	1.23	AH < NSMI (***p* = 0.013**, *d* = 0.30)
	SSBAL	3.06	1.22	
χ^2 = 16.302, ***p* = 0.006**	NSMI	3.14	1.20	
	EMC	2.90	1.20	
	HW	3.06	1.23	
	Total	3.01	1.23	

Note. UR–University Requirements; TEES–Teacher Education and Education Studies; AH–Arts and Humanities; SSBAL–Social sciences, Business, administration and law; NSMI–Natural sciences, mathematics, and ICTs; EMC–Engineering, manufacturing and construction; HW–Health and welfare.
$p < .05$ is in bold; n.s.–nonsignificant.

A Difference Among Disciplines in Students' Perception of Teacher as a Role Model

Students marked their agreement with statements on a five-point Likert scale (1–*Totally disagree to* 5–*Totally agree*). We found a statistically significant difference between the various disciplines in all scale items and H3 therefore is confirmed (Table 7). Post hoc tests identifying pairwise difference with small effect size in all items.

On average, students in total gave negative to neutral values for teachers as role models in ICT use ($2.55 \leq M \geq 3.30$). The highest value was for "Faculty is successful in using ICT for

Table 7. ANOVA and Post Hoc Test Results for Students' Perception of Teacher as a Role-Model.

Items	**Study field KLASIUS-P**	***M***	***SD***	**Between-group difference (Post hoc test /pairwise comparison)**
TM1. Faculty is successful in using ICTs for teaching.	TEES	3.37	0.98	NSMI > HW (***p* = 0.011**, *d* = 0.30)
	AH	3.20	0.99	
	SSBAL	3.35	1.00	
	NSMI	3.43	0.96	
F(5) = 3.165, ***p* = 0.008**	EMC	3.24	1.02	
	HW	3.12	1.06	
	Total	3.30	1.00	
TM2. Faculty uses innovative technological solutions.	TEES	2.80	1.02	NSMI > TEES (***p* = 0.028**, *d* = 0.29)
	AH	2.78	0.97	NSMI > AH (***p* = 0.007**, *d* = 0.31)
	SSBAL	3.02	1.08	NSMI > HW (***p* = 0.044**, *d* = 0.26)
	NSMI	3.10	1.03	
F(5) = 4.373, ***p* = 0.001**	EMC	3.04	1.00	
	HW	2.82	1.05	
	Total	2.96	1.03	
TM3. I look to faculty for how to resolve problems that may occur during ICT use.	TEES	2.44	0.96	HW < SSBAL (***p* = 0.050**, *d* = 0.27)
	AH	2.44	0.94	HW < EMC (***p* = 0.007**, *d* = 0.36)
	SSBAL	2.56	1.11	HW < NSMI (***p* = 0.001**, *d* = 0.41)
	NSMI	2.70	1.11	
χ^2 = 24.109, ***p* = 0.000**	EMC	2.63	1.00	
	HW	2.27	0.96	
	Total	2.55	1.04	
TM4. Faculty show enthusiasm for using technological solutions.	TEES	2.63	1.04	NSMI > TEES (***p* = 0.002**, *d* = 0.36)
	AH	2.73	1.02	NSMI > AH (***p* = 0.028**, *d* = 0.27)
	SSBAL	2.75	1.12	NSMI > SSBAL (***p* = 0.031**, *d* = 0.25)
	NSMI	3.02	1.12	TEES < ECM (***p* = 0.033**, *d* = 0.32)
F(5) = 5.707, ***p* = 0.000**	EMC	2.97	1.08	
	HW	2.63	1.08	
	Total	2.82	1.09	
TM5. Faculty is at least as competent as I am in using ICTs.	TEES	3.05	1.09	NSMI > AH (p **= 0. 001**, *d* = 0.41)
	AH	2.82	1.03	NSMI > SSBAL (***p* = 0.002**, *d* = 0.29)
	SSBAL	2.93	1.12	NSMI > HW (***p* = 0. 001**, *d* = 0.44)
	NSMI	3.26	1.11	HW < EMC (***p* = 0.047**, *d* = 0.30)
F(5) = 7.299, ***p* = 0.000**	EMC	3.09	1.04	
	HW	2.77	1.08	
	Total	3.01	1.10	

Note. TM-Teacher-Model; TEES–Teacher Education and Education Studies; AH–Arts and Humanities; SSBAL–Social sciences, Business, administration and law; NSMI–Natural sciences, mathematics, and ICTs; EMC–Engineering, manufacturing and construction; HW–Health and welfare. *p* < .05 is in bold; n.s.–nonsignificant;

teaching" (M = 3.30, SD = 1.00), and the lowest was "I look to faculty for how to resolve problems that may occur during ICT use" (M = 2.55, SD = 1.04).

TEES students had lower means in most items relative to students in other disciplines. In one item, however, TEES students' mean was among the highest—"Faculty is successful in using ICT for teaching"—although in this item, TEES students were not significantly different from students of other disciplines.

There was a statistically significant difference for "Faculty is successful in using ICT for teaching," as determined by one-way ANOVA, $F(5)$ = 3.165, p = 0.008. Post hoc testing revealed that NSMI students (M = 3.43, SD = 0.96) more strongly agreed that faculty is successful in using ICTs for teaching than did HW students (M = 3.12, SD = 1.06).

A one-way ANOVA determined a statistically significant difference between groups for "Faculty use innovative technological solutions," $F(5)$ = 4.373, p = 0.001. Post hoc testing of students of different study programs revealed that students of NSMI (M = 3.10, SD = 1.03) agreed less strongly that faculty use innovative technological solutions than did students in TEES (M = 2.80, SD = 1.02), AH (M = 2.78, SD = 0.97), and HW (M = 2.82, SD = 1.05). However, HW students (M = 2.82, SD = 1.05) agreed less strongly with this statement than did EMC students (M = 3.04, SD = 1.00).

Kruskal-Wallis tests identified a difference between groups for "I look to faculty for how to resolve problems that may occur during ICT use, $\chi^2(5)$ = 24.109, p = 0.000. Post hoc testing indicated that HW students (M = 2.27, SD = 0.96) agreed less strongly with this statement than did SSBAL (M = 2.56, SD = 1.11), EMC (M = 2.63, SD = 1.00), and NSMI (M = 2.70, SD = 1.11) students.

Difference between groups for "Faculty show enthusiasm for using technological solutions" was statistically significant, as determined by one-way ANOVA, $F(5)$ = 5.707, p = 0.000). Post hoc testing indicated NSMI students (M = 3.02, SD = 1.12) agreed more strongly with this statement than did TEES (M = 2.63, SD = 1.04), AH (M = 2.73, SD = 1.02), SSBAL (M = 2.75, SD = 1.12), and HW (M = 2.63, SD = 1.08) students. There was also a statistically significant difference between students of TEES (M = 2.63, SD = 1.04) and EMC (M = 2.97, SD = 1.08).

The same was true between groups for "Faculty is at least as competent as I am in using ICTs," as determined by a one-way ANOVA, $F(5)$ = 7.299, p = 0.000). Post hoc testing revealed that students of NSMI (M = 3.26, SD = 1.11) agreed more strongly with this statement than did students of AH (M = 2.82, SD = 1.03), SSBAL (M = 2.93, SD = 1.12), or HW (M = 2.77, SD = 1.08). There was also a statistically significant difference between HW (M = 2.77, SD = 1.08) and EMC (M = 3.09, SD = 1.04) students.

A Difference Among Disciplines in Students' ICT Use for Collaboration

Students assessed the frequency of items on an interval scale (1–*Never*, to 5–*Very frequently*). A statistically significant difference between different disciplines was found in four scale items. In six, there was no statistically significant difference, and H4 therefore is partly confirmed (Table 8). Post hoc tests identifying pairwise difference with small effect size in item 5. In item one, there was no effect between NSMI and SSBAL (d = 0.19), in item 2, there was no effect between NSMI and SSBAL (d = 0.15) and in item 5, there was no effect between NSMI and TEES (d = 0.17).

Table 8. ANOVA and Post Hoc Test Results for Students' ICT Use for Collaboration.

Items	Study field - KLASIUS-P	*M*	*SD*	Between-group difference (Post hoc test /pairwise comparison)
C1. I seek help online if I have a problem.	TEES	2.55	1.25	NSMI < SSBAL (**p = 0.027**, d = 0.19)
	AH	2.73	1.34	
	SSBAL	2.80	1.24	
$\chi^2 = 12.367$, $\boldsymbol{p = 0.030}$	NSMI	2.55	1.36	
	EMC	2.71	1.22	
	HW	2.61	1.30	
	Total	2.66	1.29	
C2. I share information related to my courses on social media sites.	TEES	2.11	1.15	NSMI < SSBAL (***p*** **= 0.041**, d = 0.15)
	AH	2.21	1.19	
	SSBAL	2.23	1.20	
$\chi^2 = 14.177$, $\boldsymbol{p = 0.015}$	NSMI	2.04	1.20	
	EMC	2.04	1.14	
	HW	2.19	1.20	
	Total	2.13	1.18	
C3. I participate in social network sites discussions from my study field.	TEES	2.09	1.23	n.s
	AH	2.20	1.18	
	SSBAL	2.28	1.19	
	NSMI	2.23	1.28	
$F(5) = 5.160$, $p = 0.397$	EMC	2.22	1.30	
	HW	2.17	1.14	
	Total	2.21	1.22	
C4. I follow the educational content suggested by computer recommendation systems (e.g., on multimedia platforms, social networks, online news).	TEES	2.11	1.18	n.s
	AH	2.28	1.12	
	SSBAL	2.38	1.12	
	NSMI	2.26	1.36	
	EMC	2.17	1.18	
$\chi^2 = 8.333$, $p = 0.139$	HW	2.21	1.08	
	Total	2.25	1.11	
C5. I participate actively in online communities in my study field where I know the majority of participants.	TEES	3.70	1.41	AH < TEES (***p*** **= 0.033**, *d* = 0.24)
	AH	3.36	1.41	SSBAL < TEES (***p*** **= 0. 036**, *d* = 0.25)
	SSBAL	3.34	1.37	NSMI < TEES (***p*** **= 0.027**, *d* = 0.17)
	NSMI	3.46	1.36	
$\chi^2 = 18.089$, $\boldsymbol{p = 0.003}$	EMC	3.46	1.30	
	HW	3.70	1.28	
	Total	3.49	1.36	
C6. I use synchronous communication e-tools for communicating with other students while learning (e.g., Skype, Facebook Messages, gTalk, Viber).	TEES	3.46	1.78	n.s
	AH	3.23	1.37	
	SSBAL	3.53	1.76	
	NSMI	3.40	1.94	
	EMC	3.34	1.82	
	HW	3.60	1.47	
$\chi^2 = 10.077$, $p = 0.073$	**Total**	3.44	1.34	

Table 8. ANOVA and Post Hoc Test Results for Students' ICT Use for Collaboration (continued)

C7. I post blogs on the Web with content from my study field (e.g., long posts on social networks, a stand-alone blog, use of blog platforms, online weblog writing).	TEES	1.42	.72	n.s
	AH	1.64	1.11	
	SSBAL	1.57	0.95	
	NSMI	1.49	0.86	
	EMC	1.48	0.78	
	HW	1.48	0.74	
$\chi^2 = 7.144$, $p = 0.210$	**Total**	1.52	0.94	
C8. I co-create documents for my course learning (e.g., Google Docs, Wiki).	TEES	2.51	1.36	ECM < SSBAL (***p* = 0.001**, *d* = 0.30)
	AH	2.59	1.37	NSMI < SSBAL (***p* = 0.039**, *d* = 0.21)
	SSBAL	2.92	1.44	
	NSMI	2.61	1.39	
$\chi^2 = 19.195$, $\mathbf{p = 0.002}$	EMC	2.49	1.34	
	HW	2.86	1.39	
	Total	2.64	1.39	
C9. I use news aggregators (RSS feed, e.g., feedly.com).	TEES	1.31	0.65	n.s
	AH	1.41	0.66	
$\chi^2 = 10.738$, $p = 0.057$	SSBAL	1.43	0.69	
	NSMI	1.42	0.83	
	EMC	1.42	0.63	
	HW	1.27	0.42	
	Total	1.39	0.82	
C10. I share my own files for learning with others (e.g., Google Drive, Dropbox).	TEES	3.39	1.30	n.s
	AH	3.11	1.34	
	SSBAL	3.31	1.31	
	NSMI	3.23	1.30	
$F(5)$ 10.435, $p = 0.064$	EMC	3.41	1.26	
	HW	3.23	1.23	
	Total	3.27	1.30	

Note. C–Collaboration; TEES–Teacher Education and Education Studies; AH–Arts and Humanities; SSBAL–Social sciences, Business, administration and law; NSMI–Natural sciences, mathematics, and ICTs; EMC–Engineering, manufacturing and construction; HW–Health and welfare.
$p < .05$ is in bold; n.s.–nonsignificant;

TEES students had lower means relative to students of other disciplines only in 4 items of 10. The highest mean for TEES students was for "I participate actively in an online community of my study field where I know the majority of participants." TEES students also had a high mean for "I use computer-supported collaborative learning" and for "I share my own files for learning with others."

Kruskal-Wallis testing indicated significant differences for participating in online communities where participants are known, $\chi^2(5) = 18.089$, $p = 0.003$. Post hoc testing indicated AH ($M = 3.36$, $SD = 1.41$), SSBAL ($M = 3.34$, $SD = 1.37$), and NSMI ($M = 3.46$, $SD = 1.36$) students participated less frequently in online communities than did TEES students ($M = 3.70$, $SD = 1.41$).

Further, Kruskal-Wallis testing indicated significant differences for co-creating documents for course learning, $\chi^2(5) = 19.195$, $p = 0.002$. Post hoc testing indicated EMC students (M =

2.49, *SD* = 1.34) co-created groups less frequently than did students of SSBAL (*M* = 2.92, *SD* = 1.44). Post hoc testing also indicated NSMI students (*M* = 2.61, *SD* = 1.39) co-created groups less frequently than did SSBAL students (*M* = 2.92, *SD* = 1.44).

Kruskal-Wallis testing indicated significant differences for “I seek help online if I have a problem,” $\chi^2(5) = 12.367$, $p = 0.030$. In this area, NSMI students (*M* = 2.55, *SD* = 1.36) revealed they seek help less frequently than do SSBAL students (*M* = 1.24, *SD* = 2.80).

Kruskal-Wallis testing indicated significant differences for “I share information related to my courses on social media sites” $\chi^2(5) = 14.177$, $p = 0.015$). NSMI students (*M* = 2.04, *SD* = 1.20) share information less frequently than do SSBAL students (*M* = 2.23, *SD* = 1.20). We found no difference in the following items: “Participating in SNS discussions in my study discipline” and “Sharing own files for learning.”

A Difference Among Disciplines in Student’s Beliefs About ICT Use

Students marked their agreement with statements on a Likert scale (1–*Totally disagree to* 5–*Totally agree*). We found a statistically significant difference between study disciplines in eight items (Table 9). In seven items, there were no differences, therefore confirming H5 partly. In 9 items of 15, TEES students had lower means than did students of other disciplines. Post hoc tests identifying pairwise difference with small effect size in majority of items. The pairwise difference with medium effect size was identified in the “Learning with ICTs is more fun than traditional learning.” between TEES and SSBAL (*d* = 0.66) and between AH and SSBAL (*d* = 0.55), EMC and SSBAL (*d* = 0.77). The pairwise difference with medium effect size was identified in the “Information gathered online is better than information from other sources” between AH and HW (*d* = 0.67) and between AH and SSBAL (*d* = 0.55). In two items there was no effect, in item 5, between AH and HW (d = 0.18), and in item 13, between NSMI and SSBAL (d = 0.17).

Kruskal-Wallis testing indicated significant differences for the belief “Learning with ICT is more fun than traditional learning,” $\chi^2(5) = 20.880$, $p = 0.001$. Post hoc testing revealed TEES students (*M* = 3.10, *SD* = 1.10) believed this more strongly than did SSBAL students (*M* = 2.36, *SD* = 1.13) but significantly more weakly than did HW students (*M* = 3.41, *SD* = 1.29). Post hoc testing revealed that AH students (*M* = 3.03, *SD* = 1.30) and EMC students (*M* = 3.17, *SD* = 0.96) also believed this more strongly than did SSBAL students (*M* = 2.36, *SD* = 1.13). Additionally, AH (*M* = 3.03, *SD* = 1.30), EMC (*M* = 3.17, *SD* = 0.96), and NSMI (*M* = 3.22, *SD* = 1.21) students believed this more weakly than did HW students (*M* = 3.41, *SD* = 1.29).

There was a statistically significant difference between groups as determined by one-way ANOVA for “I have better grades because of use of ICTs for learning,” $F(5) = 21.137$, $p = 0.001$. Post hoc testing identified that TEES students believed this less strongly (*M* = 2.84, *SD* = 1.12) than did HW students (*M* = 3.10, *SD* = 1.07), EMC students (*M* = 3.12, *SD* = 1.13), SSBAL students (*M* = 3.17, *SD* = 1.01), or NSI students (*M* = 3.22, *SD* = 1.21). Less strong beliefs were identified also for AH students (*M* = 2.91, *SD* = 1.24) as compared to SSBAL students (*M* = 3.17, *SD* = 1.01) and NSI students (*M* = 3.22, *SD* = 1.21).

Kruskal-Wallis testing indicated significant differences for the item “When I use ICTs, I am more curious during learning,” $\chi^2(5) = 15.505$, $p = 0.008$. Post hoc testing showed TEES students (*M* = 3.04, *SD* = 1.27) believed this less strongly than did NSMI students (*M* = 3.29, *SD* = 1.07), SSBAL students (*M* = 3.39, *SD* = 1.05), and HW students (*M* = 3.44, *SD* = 1.12). And AH students (*M* = 3.20, *SD* = 1.33) believed this less strongly than did HW students (*M* = 3.44, *SD* = 1.12).

Table 9. ANOVA Results for Student's Beliefs About ICT Use.

Items	Study field - KLASIUS-P	*M*	*SD*	Between-group difference (Post hoc test /pairwise comparison)
BEL1. Using ICTs for learning allows me to customize the learning process to my needs.	TEES	3.49	0.96	n.s
	AH	3.49	1.24	
	SSBAL	3.70	1.00	
	NSMI	3.64	1.01	
	EMC	3.50	0.97	
$\chi^2 = 11.008$, $p = 0.051$	HW	3.68	0.93	
	Total	3.60	1.01	
BEL2. Learning with ICTs is more fun than traditional learning.	TEES	3.10	1.10	TEES > SSBAL (***p* = 0.013**, *d* = 0.66)
	AH	3.03	1.30	TEES < HW (***p* = 0.004**, *d* = 0.25)
	SSBAL	2.36	1.13	AH > SSBAL (***p* = 0.001**, *d* = 0.55)
	NSMI	3.22	1.21	AH < HW (***p* = 0.001**, *d* = 0.29)
$\chi^2 = 20.880$, ***p* = 0.001**	EMC	3.17	0.96	EMC > SSBAL (***p* = 0.037**, *d* = 0.77)
	HW	3.41	1.29	EMC < HW (***p* = 0.010**, *d* = 0.21)
	Total	3.22	1.08	NSMI < HW (***p* = 0.027**, *d* = 0.15)
BEL3. I have better grades because of use of ICTs for learning.	TEES	2.84	1.12	TEES < HW (***p* = 0.040**, *d* = 0.23)
	AH	2.91	1.24	TEES < EMC (***p* = 0.020**, *d* = 0.25)
	SSBAL	3.17	1.01	TEES < SSBAL (***p* = 0.002**, *d* = 0.30)
	NSMI	3.22	1.21	TEES < NSMI (***p* = 0.001**, *d* = 0.32)
F(5) = 21.137, ***p* = 0.001**	EMC	3.12	1.13	AH < SSBAL (***p* = 0.006**, *d* = 0.22)
	HW	3.10	1.07	AH < NSMI (***p* = 0.001**, *d* = 0.25)
	Total	3.09	1.07	
BEL4. ICT use allows me to be more creative in learning.	TEES	3.11	1.08	n.s
	AH	3.17	1.12	
	SSBAL	3.27	0.99	
	NSMI	3.12	1.09	
F(5) = 5.558, *p* = 0.352	EMC	3.15	0.99	
	HW	3.28	1.01	
	Total	3.16	1.05	
BEL5. When I use ICTs, I am more curious during learning.	TTES	3.04	1.27	TEES < NSMI (***p* = 0.003**, *d* = 0.21)
	AH	3.20	1.33	TEES < SSBAL (***p* = 0.005**, *d* = 0.30)
	SSBAL	3.39	1.05	TEES < HW (***p* = 0.001**, *d* = 0.32)
	NSMI	3.29	1.07	AH < HW (***p* = 0.035**, *d* = 0.18)
$\chi^2 = 15.505$, ***p* = 0.008**	EMC	3.23	1.10	
	HW	3.44	1.12	
	Total	3.49	1.36	
BEL 6. ICT use supports me in better collaboration with others.	TEES	3.47	1.04	n.s
	AH	3.43	1.14	
	SSBAL	3.70	0.93	
	NSMI	3.55	0.99	
F(5) = 2.146, *p* = 0.056	EMC	3.56	0.97	
	HW	3.59	0.92	
	Total	3.55	1.00	

Table 9. ANOVA Results for Student's Beliefs About ICT Use. (continued)

BEL7. ICTs allow me to learn anywhere.	TEES	3.64	1.29	n.s
	AH	3.50	1.42	
	SSBAL	3.77	1.20	
χ^2 = 8.086, p = 0.152	NSMI	3.61	1.31	
	EMC	3.57	1.28	
	HW	3.68	1.21	
	Total	3.63	1.13	
BEL8. Others (e.g., professors, colleagues) can see positive results, when I can use ICTs for learning.	TEES	2.61	0.89	n.s
	AH	2.69	1.02	
	SSBAL	2.81	1.02	
	NSMI	2.77	1.00	
	EMC	2.72	1.04	
	HW	2.57	1.08	
χ^2 = 10.628, p = 0.059	**Total**	2.71	1.00	
BEL9. Information gathered online is better than information from other sources.	TEES	2.50	0.75	AH < EMC (***p* = 0.019**, *d* = 0.34)
	AH	2.23	0.96	AH < NSMI (***p* = 0.001**, *d* = 0.46)
	SSBAL	2.75	0.91	AH < HW (***p* = 0.001**, *d* = 0.67)
	NSMI	2.59	0.91	AH < SSBAL (***p* = 0.001**, *d* = 0.55)
	EMC	2.53	0.76	TEES < SSBAL (***p* = 0.003**, *d* = 0.29)
χ^2 = 29.704, ***p* = 0.000**	HW	2.86	0.92	ECM < SSBAL (***p* = 0.008**, *d* = 0.26)
	Total	2.57	0.94	NSMI > SSBAL (***p* = 0.024**, *d* = 0.21)
BEL10. On the Web, I have access to learning information I could not get anywhere else.	TEES	3.59	1.11	n.s
	AH	3.72	1.07	
	SSBAL	3.85	0.96	
	NSMI	3.80	1.03	
	EMC	3.66	0.98	
F(5) = 10.724, p = 0.057	HW	3.78	1.08	
	Total	3.75	1.01	
BEL11. ICT use offers me a feeling of belonging to a group.	TEES	2.56	1.01	n.s
	AH	2.46	1.11	
	SSBAL	2.67	1.09	
	NSMI	2.52	1.11	
F(5) = 8.027, p = 0.155	EMC	2.47	1.08	
	HW	2.63	1.15	
	Total	2.55	1.09	
BEL12. Using the Web for learning, I can get access to more information than with any other source (e.g., books, professors).	TEES	2.95	1.29	AH < EMC (***p* = 0.004**, *d* = 0.28)
	AH	2.89	1.29	AH < SSBAL (***p* = 0.001**, *d* = 0.38)
	SSBAL	3.35	1.12	AH < NSMI (***p* = 0.001**, *d* = 0.28)
	NSMI	3.24	1.18	AH < HW (***p* = 0.001**, *d* = 0.38)
	EMC	3.22	1.05	TEES < EMC (***p* = 0.031**, *d* = 0.29)
	HW	3.36	1.15	TEES < SSBAL (***p* = 0.001**, *d* = 0.33)
χ^2 = 38.359, ***p* = 0.000**	**Total**	3.22	1.09	TEES < NSMI (***p* = 0.001**, *d* = 0.23)
				TEES < HW (***p* = 0.001**, *d* = 0.33)

Table 9. ANOVA Results for Student's Beliefs About ICT Use. (continued)

BEL13. Using ICTs for learning allow me to get to know other people better.	TEES	3.28	1.28	TEES < SSBAL (***p* = 0.007**, *d* = 0.23)
	AH	3.42	1.41	NSMI < SSBAL (***p* = 0.006**, *d* = 0.17)
	SSBAL	3.59	1.41	
	NSMI	3.35	1.28	
	EMC	3.37	1.24	
χ^2 = 11.522, ***p* = 0.042**	HW	3.38	0,79	
	Total	3.41	1.11	
BEL14. Using ICTs allow me better personal interaction with academic staff.	TEES	2.42	1.03	HW < NSMI (***p* = .021**, *d* = 0.22)
	AH	2.51	1.11	HW < EMC (***p* = .014**, *d* = 0.25)
	SSBAL	2.55	1.09	HW < AH (***p* = .007**, *d* = 0.27)
	NSMI	2.47	1.20	HW < SSBAL (***p* = 0.001**, *d* = 0.31)
	EMC	2.48	1.07	
χ^2 = 11.690, ***p* = 0.039**	HW	2.23	0.92	
	Total	2.46	1.04	
BEL15. On the Web, I can follow better trends in my study field.	TEES	3.76	1.00	TEES < EMC (***p* = 0.015**, *d* = 0.25)
	AH	4.00	1.05	TEES < SSBAL (***p* = 0.007**, *d* = 0.30)
	SSBAL	4.03	0.77	TEES < AH (***p* = 0.005**, *d* = 0.23)
	NSMI	4.08	0.86	TEES < HW (***p* = 0.003**, *d* = 0.31)
χ^2 = 14.130, ***p* = 0.015**	EMC	4.00	0.87	TEES < NSMI (***p* = 0.001**, *d* = 0.34)
	HW	4.07	0.85	
	Total	4.01	0.94	

Note. BEL–beliefs; TEES–Teacher Education and Education Studies; AH–Arts and Humanities; SSBAL–Social sciences, Business, administration and law; NSMI–Natural sciences, mathematics, and ICTs; EMC–Engineering, manufacturing and construction; HW–Health and welfare; $p < .05$ is in bold; n.s.–nonsignificant;

Significant differences in agreement with "Information gathered online is better than information from other sources," $\chi^2(5) = 29.704$, $p = 0.000$, was revealed by the Kruskal-Wallis testing. Post hoc testing indicated AH students (*M* = 2.23, *SD* = 0.96) agreed less strongly with this statement than did EMC (*M* = 2.53, *SD* = 0.76), NSMI (*M* = 2.59, *SD* = 0.91), HW (*M* = 2.86, *SD* = 0.92), and SSBAL (*M* = 2.75, *SD* = 0. 91) students. TEES students (*M* = 2.50, *SD* = 0.75) and EMC students (*M* = 2.53, *SD* = 0.76) also agreed less strongly than did SSBAL students (*M* = 2.75, *SD* = 0. 91). NSMI students agreed more strongly than did SSBAL students.

Kruskal-Wallis testing also indicated significant differences for agreement with "When using the Web for learning, I can get access to more information than with any other source (e.g., books, professors)," $\chi^2(5) = 38.359$, $p = 0.000$. Post hoc testing showed that AH students (*M* = 2.89, *SD* = 1.29) and TEES students (*M* = 2.95, *SD* = 1.29) agreed less strongly to this statement than did students of EMC (*M* = 3.22, *SD* = 1.05), SSBAL (*M* = 3.35, *SD* = 1.12), NSMI (*M* = 3.24, *SD* = 1.18), and HW (*M* = 3.86, *SD* = 1.15).

Significant differences in agreement with the statement, "Using ICTs for learning allows me to get to know other people better," $\chi^2(5) = 11.522$, $p = 0.042$, were revealed through the Kruskal-Wallis testing. Post hoc testing indicating TEES students (*M* = 2.42, *SD* = 1.03) and NSMI students (*M* = 3.35, *SD* = 1.28) agreed less strongly than did SSBAL students (*M* = 3.59, *SD* = 1.41).

Kruskal-Wallis testing indicated significant differences in agreement with "Using ICT allows me better personal interaction with academic staff," $\chi^2(5) = 11.690$, $p = 0.039$. Post hoc testing showed that HW students (M = 2.23, SD = 0.092) agreed less strongly to this belief than did NSMI students (M = 2.47, SD = 1.20).

Furthermore, Kruskal-Wallis testing revealed significant differences for the belief, “On the Web, I can better follow trends in my study field,” $\chi^2(5) = 14.130$, $p = 0.015$. Post hoc testing indicating TEES students (M = 3.76, SD = 1.00) agreed less strongly with this than did students in all other disciplines.

No significant difference was found for the items: “Using ICTs for learning allows me to customize the learning process to my needs;” “I am more creative in learning, because of ICT use;” “Using ICTs for learning allows me better collaboration with others;” “ICTs allows me to learn anywhere;” “Others (e.g., professors, colleagues) can see positive results when I can use ICTs for learning;” “On the Web I have access to learning information I could not get anywhere else;” and “Using ICTs for learning gives me feelings of belonging to the group.”

DISCUSSION

Higher education prepares graduates for the requirements of dynamic work contexts with rapid technological innovation by providing opportunities to develop professional competences as a component of the study-field curriculum. An essential characteristic of a future professional is the readiness for lifelong learning and competent work with technologies. Subject-specific competences in higher education curricula need to be delivered through the integration of 4C processes and skills for working with technology; it already has been established that technology integration into teaching and learning in university learning environments makes an important contribution to students’ development of various competences and skills (Adams Becker et al., 2017; Jääskelä et al., 2017). Additionally, prior research has established that technology integration in higher education teaching currently is insufficient (Instefjord & Munthe, 2017) and that teaching with ICT integration provides students with authentic learning experiences (Istenič Starčič et al., 2018). Authenticity in teaching is achieved by integrating students’ existent ICT practices with anticipated professional ICT practices. It supports enactive learning in terms of learning by doing and vicarious learning by observing the performance of someone modeling the skills (Bandura, 1971, 1986).

Previous research suggests disciplinary differences in digital competence (Owens & Lilly, 2017) and ICT integration in higher education (Croteau et al., 2015). Our research was motivated by interest in the differences in ICT integration within university learning environments. Our findings demonstrate several differences among students in various disciplines within a single university.

In the Results section, we identified that, overall, the frequency of technology use is not very high and that students of different disciplines varied significantly regarding their use of ICTs in an academic environment, how ICTs are integrated within their learning environments, and how they viewed their teachers as good models for employing ICTs for learning and collaboration. In this section, we discuss how TEES students are different from other disciplines. TEES students will, in their professional practice, prepare future young generations of students for life and work in digitalized society.

The Difference Among Disciplines in Students' Perceptions of Teacher's ICT Integration in Teaching Corresponding to the Frequency of ICT Use by Teachers

Concerning technology integration in higher education in terms of their teachers' frequency of technology use in teaching, we identified differences in three scale items of five. Specifically, the data revealed differences in "ICT use during classroom lectures and tutorials for students' activities," "ICT use outside classroom lectures for learning content prior to organized class lectures," and "ICT use for feedback and assessment." TEES students perceived that teacher-educators organize ICT-supported collaboration activities during classroom lectures more than was perceived for teachers in other disciplines. However, TEES students perceive that their educators rarely conducted a flipped classroom or facilitated BYOD. Based on these findings, we could conclude that ICT utilization for TEES in providing feedback and assessment is insufficient. Computer-assisted feedback and assessment to support students' informed learning decisions is important for current and future trends and should be introduced to student teachers. Second, an important conclusion regarding TEES students is the need for populating flipped classroom activities utilizing online learning resources. Offering a variety of resources for enhancing students' self-directed learning and for merging imposed and selected learning environments.

The Difference Among Disciplines in Students' Perceptions of University's Requirements for ICT Use

Regarding technology integration requirements in the university learning environment, interdisciplinary differences were apparent in all scale items. TEES students had relatively higher means than other groups for "I am required to use ICTs for which I do not get adequate training" and "I am required to use ICTs for computer-supported collaborative learning." Their mean scores were the second highest in both areas. For the statement, "I am required to use ICTs for independent study," the TEES students' mean was the highest.

Our findings about TEES students show they perceive the requirements of their university learning environments in favor of computer-supported collaborative learning and for independent study. Based on these results, we could conclude that university requirements generally support students in developing self-regulation skills for learning from online learning resources. Computer-supported collaborative learning offers significant potential for learning about new technologies and technology integration in teaching. Referring to TEES students specifically, the indication of their lack of ICT training should be examined in the future. To benefit these students, it would be important to identify which tools and technologies they are skilled in currently and what is expected from them to develop on their own.

The Difference Among Disciplines in Students' Perceptions of the Teacher as a Role Model in Technology Integration

Differences exist in all items of the scale for this focus area. Related research highlighted that initial teachers' education has a high potential for developing student teachers' competences for technology integration (Drent & Meelissan, 2008; Paratore et al., 2016), which will in turn influence future generations of students when the student teachers start their professional pedagogical practice. Related research identified great potential for the teacher-educator as a role model and designer of the digitalized curriculum (Katyal & Evers, 2004; Lai, 2015; Tondeur et al., 2016). Our findings show that, compared with other disciplines and as perceived by their students, teacher-educators are effective, from a professional competence standpoint, in designing and role modeling the integration of ICTs into the curriculum. TEES students’ perceptions of their teacher-educators as successful in using ICTs are second only to students in NSMI, a field that includes the study of ICTs. TEES students also felt that teacher-educators are at least as competent in ICT use, which is in line with the perceptions of students in NSMI and EMC.

We found, however, that students wanted teachers to play a more active role in leading technology innovation in educational environments. Students from ICT-specific disciplines perceived programs and professionals as equally good in achieving this due to highly specific and up-to-date technological and content knowledge. These NSMI students’ perspectives were revealed as significantly different from other disciplines, both in using innovative solutions and being enthusiastic about ICT use. TEES students, however, did not perceive their teachers to be very advanced in using innovative technological solutions; the same applies to enthusiasm about ICT use. Pintrich and Schunk (1996) defined enthusiasm and credibility as characteristics of a good role model. TEES, AH, and HW students differed significantly from students in NSMI in their perceptions about teachers’ use of innovative technological solutions. With regard to enthusiasm for ICT use, TEES, AH, and SSBAL students’ perceptions varied significantly from NSMI students. TEES students also significantly varied from ECM students.

We could conclude that, as perceived by their students, teacher-educators are effective in designing and role-modeling the integration of ICTs when compared to other disciplines. They are not perceived, however, as leaders in new technology use. In their research in Flanders, Belgium, Tondeur et al. (2016) concluded that teacher-educators do not provide sufficient modeling regarding using ICTs as components of their pedagogical practices. In Norway, Instefjord and Munthe (2017) found that preservice teachers have very diverse perceptions of their teacher-educators as role models generally and, on average, a neutral perception of teacher-educators as role models in ICT integration in teaching.

Researchers in one study from Canada identified a negative correlation between perceived teachers’ ICT integration and perceived learning gain among students of different disciplines (Venkatesh et al., 2014). Another study of Canadian teachers established that teacher-educators perceive a limited potential for ICT use in higher-education teaching in contributing to students’ learning (Croteau et al., 2015). Therefore, both sides of this issue (i.e., the students’ and the teachers’ views of contributions of ICTs to students’ learning) need to be examined further. The ICT integration in the education process is a complex issue, context dependent, and related to a set of factors and its interplay. On the other hand, technology development is rapid, which requires teachers take into consideration a critical evaluation of diverse issues and factors.

The Difference Among Disciplines in Students’ Perceptions of ICT Use for Collaboration

We identified a statistically significant difference between disciplines in 4 scale items of 10 regarding ICT use for collaboration. Of all disciplines, TEES students used ICTs most frequently for participating in online communities where they knew the majority of students. In this, they differed significantly from AH, SSBAL, and NSMI students. TEES students also engaged in computer-supported collaborative learning and shared their own files for learning with fellow students more frequently than did students from most of the other disciplines. They did not lead, however, in activities in social networks, such as engaging in discussions, following educational content suggested by computer-recommendation systems, or posting blogs with content from their study field. TEES students also sought help online least frequently and were less likely to utilize social networking frequently for co-creating documents; however, they quite frequently share resources and information. Related research among university students in USA identified student participation in Internet-facilitated collaboration, project work, exchanging notes, sharing, and ICT use for studying for exams (Jones, Johnson-Yale, Millermaier, & Perez, 2008). TEES students seem to build social groups to support their learning process in collaboration with classmates and people they know and tend to exploit social networking more for interacting in a familiar environment. In their professional role, however, they will be expected to build relationships in new groups and interact with people they do not know. Therefore, these key expectations of a teacher-educators need to be clarified and examined further.

The Difference Among Disciplines in Students' Beliefs About ICT Use

Statistically significant differences were evident in 8 of 15 scale items in this area. Beliefs about ICT use are predictors of its use (Sang et al., 2010), and such beliefs need to be examined in the higher education environment for two main and interconnected reasons. First, the educational sector has a low ranking on the Sector Digitalisation Index (Manyika, 2015), despite the important role that classroom teachers play in developing the digital competences of the upcoming generations of students. Second, initial education is regarded as having the potential for transforming beliefs (Paratore et al., 2016) that could reduce the attitude–behavior gap (Istenič Starčič et al., 2018).

In related studies, beliefs about ICTs in learning refer to improving learning performance, efficiency, individualization and differentiation in learning, and the level of creativity of students (Sang et al., 2010). ICTs also are essential components of the observability of results and for facilitating flexibility in learning (van Braak & Tearle, 2007).

We examined beliefs about ICT use in learning by referring to collaboration as the main affordance of ICTs (Conole & Dyke, 2004), their potential for student-centered teaching (Means & Olson, 1997), and as a result of ICT integration (Hao & Lee, 2017; Hattie, 2009; Tondeur et al. 2016). Our findings indicate that no significant difference exists between disciplines regarding beliefs about ICT use for collaboration or whether it enhances feelings of belonging. TEES students have less strong beliefs regarding ICTs providing better personal interaction with academic staff or allowing them to know other people better. A study by Jones et al. (2008) found that Internet use had a positive impact on relationships among classmates and that online communication is used extensively for communicating with professors.

Referring to creativity, we examined beliefs about a student feeling more creative when using ICTs as well as technologies' ability to further curiosity, fun, and flexibility in learning. In the present study, we identified no significant difference among the disciplines in their perceptions or their practices of being more creative in learning because of ICT use. We found, however, in comparison to SSBAL students, that TEES students have stronger beliefs about ICTs providing fun environments. They have less strong beliefs about items referring to ICT use in learning for curiosity. And there was no difference among their peers from other academic fields regarding the observability of learning outcomes.

Regarding flexibility in learning, we found no significant difference among the student groups in terms of customizing the learning process to student needs, the opportunity for learning anywhere, or access to information that could not be accessed elsewhere. TEES students had less strong beliefs about customizing the learning process to their personal needs, the availability of information online (i.e., better information than elsewhere or more information than elsewhere), or that professors can see results, when using ICT for learning.

CONCLUSIONS

Our study compared the effectiveness of ICT integration across disciplines and revealed several differences that rarely have been explored in prior research. The study was an exploratory one, conducted in a single institution, with the goal of identifying issues for future study. The sample size was small, considering the large number of students invited to participate. The most likely reason for this is that authors conducted the study during the examination period, which not the best time to ask students to participate in a survey. Despite the low participation rate, the data collected did contribute to our goals of identifying and understanding better the issues and surfacing questions for further research.

The self-reported perceptions provide only a partial insight into the myriad issues of technology-enhanced learning environments. An in-depth analysis of the topic generally, and of any research finding specifically, would require a mixed-method study of a larger sample of students and teachers, following, perhaps, the methods applied in a Canadian study (Croteau et al., 2015), in which large differences were established between teachers' and students' views.

Technology integration refers to a wide spectrum of tools and online learning resources. Effective implementation of any such practices requires the analysis of diversified educational technologies in various contexts, disciplines, and learning methods. Moreover, the increasing requirements for digitalization of higher education requires a comparative analysis of students' and teachers' experiences to inform technology integration. In the future, various factors that are context dependent and related to students and teachers should be examined with explanations provided for their predictive power to development of students' 21st-century skills.

Among reasons reported for insufficient ICT integration in teaching are the lack of research and training at the tertiary level (Instefjord & Munthe, 2017) and lack of understanding of higher education teachers' beliefs about technology-integrated teaching and learning (Jääskelä et al., 2017). Our research addressed part of this gap, providing some insight into students' perceptions that should help guide teachers' pedagogical decisions and institutional and system interventions for enhancing teachers' pedagogical competences towards increased impacts on graduates professional competency.

The education sector, being very low on the Sector Digitalisation Index (Manyika, 2015), is facing the requirement to educate the university-aged population for lives and professions in a digitalized society. The P21 project established that students develop professional competences when learning skills and skills for work with technology are integrated (P21, 2012; P21 & AACTE, 2010). The findings of the present study indicate differences among academic disciplines that suggest such differences need to be explored from a variety of teaching and learning perspectives. Future research must consider students' life experiences and the expectations of the university learning environment in relation to real-life professional contexts (Istenič Starčič et al., 2018).

The present study identifies teachers as role models, highlighting their leading role in ICT use and advancing the professional use of ICTs. TEES students identified teacher-educators as currently not playing the role of leaders in bringing technological innovation into the classroom or curriculum. Students' beliefs about ICT use show that TEES students have less strong beliefs about ICTs supporting interaction and devising online information. This is in line with the deficiency identified in social network practices, discussing in social networks in the study field, posting blogs, deploying recommendation systems, and co-creating documents, when compared to students in other disciplines.

Based on findings, we identified a need for teacher-educators addressing rapidly developing technological innovation and its efficiency for interaction in learning process and learning environment design. In the future, these needs, among many, require broader examination as a foundation for preparing future educational professionals for ongoing work with technology and for technology use in lifelong learning. In a technologically rapidly developing society, teacher-educators must design their teaching practices in the present for their students' benefit in the future, and thus must critically address the constantly evolving technology.

In line with related studies, the findings of the present study establish the difference in ICT implementation in teaching and learning among higher education professional disciplines (Croteau et al., 2015). So although this paper has focused on the implications of our findings for students in the education discipline, broader and deeper exploration other disciplines regarding these issues are needed in the future.

IMPLICATIONS FOR RESEARCH AND APPLICATION

The findings of this exploratory study raise questions about instructional design in all disciplines when integrating a guided learning environment, which is imposed by a university, with the unstructured learning environment driven by student planning. From a research perspective, this study contributes to the limited current findings regarding students' perceptions of technology integration as useful for their current learning and future professional applications. Thus, it provides a basis for larger studies of this nature and for deeper investigation into the myriad issues related to the triad of technology-enhanced learning—from the universities' directives, to the teachers' implementations of new ICT-based pedagogical practices, to the students' embracing and encouraging effective and integrated use of technologies that will prepare them better for their transitions to ICT-infused professional environments. It is especially important to look at authentic ICT use, which enhances teaching and learning in and of itself as well as develops students' subject-specific professional competences.

With students and teacher-educators in the education field as a focus in this study, our research provides evidence that more study of the specific formation of future teachers is essential for creating environments and academic structures aimed at the influences on future learning. Even now, however, instructional design must provide student teachers with opportunities for selecting and making decisions in creating their personal digital learning environments and networks. This emphasis on studying and developing the ICT-based skills for tomorrow's teaching professionals rests particularly on social media, activities widely engaged by the current young generation of students. Teachers' social media use and competences should be examined more closely. Moreover, current and future teachers need support and data to address the challenges raised by the digitalization of childhood, in terms of both the learning potential of students’ familiarity with specific ICTs and the consequent problems and educational impact caused by compulsive use of social media.

From the application perspective, the results of our study clearly indicate that some changes already can be implemented in ICT-based higher education. At the university level, planning for the digitalized curriculum requires sufficient time, training, and investment in a larger variety of learning methods, learning technologies, and collaborative activities for both teachers and students. For the teachers, tools and research already exist on ways they can design their current and future curricula and pedagogical decisions to address students’ creativity and engagement in collaborative work with technology to raise their capabilities for being autonomous, self-directive, and self-efficient in their workplaces. Teachers also can immediately take on the clear understanding that they, as professionals, are role models for ICT use and for the ongoing process of lifelong learning of new processes and technologies. On the other hand, students need to develop not only an understanding of the various ways ICTs can enhance their current studies and future work-related activities, but also take an active role in underscoring the need for these with both university administrators and in-class educators. In that way, students serve as co-creators—or at least motivators—of flexible and responsive curricula for their fields of study.

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