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RESEARCH-BASED LEARNING DURING A PANDEMIC – FINDINGS FROM A COURSE ON BUSINESS INFORMATICS CONDUCTING RESEARCH ON BARRIERS TO DIGITAL TRANSFORMATION

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Abstract: Digital Transformation is a ubiquitous process envisioned to enhance operations, business models, and customer contact. Practically, barriers stand in the way of these enhancements. In a Master's course on Business Informatics, a research-based learning design was used to research these barriers. Furthermore, the research-based learning design was expected to generate a positive student engagement, as the course had to be adopted to Covid-19 teaching policies. Results of the data generated throughout the course show a high explanation power of the applied barrier model as the adjusted R^2 is 0,648. In the evaluation of the course design, students perceive the effects of the research-based design on their understanding and their critical thinking as excellent.

Keywords: Digital Transformation, barriers, research-based learning, Covid-19

INTRODUCTION

Digital transformation (DT) is a concept aiming to enable significant improvements within organizations when it comes to processes, business models, and closer connections to stakeholders by the usage of modern digital technologies (Fitzgerald, Kruschwitz, Bonnet, & Welch, 2013). All parts of society and the economy experience DT's effects. Higher education (HE) is not excluded from these experiences (Castro, 2019). DT in HE impacts administrative processes, teaching methods, and learning habits. E-technologies support processes in learning and enhance assessments of learning outcomes. Also, digital technologies transform access to learning materials, communication between learners and instructors, and collaboration amongst learners. Research indicates a high potential. Nevertheless, higher education institutions (HEIs) need to make sense of digital technologies and incorporate them into a seamless learning experience. HEIs use digital content in online learning environments already. Often, its use was occasionally and at experimental stages, particularly at campus-based universities (Dwivedi, 2018).

The Covid-19 pandemic obliged HEIs to work on their DTs (García-Morales, Garrido-Moreno, & Martín-Rojas, 2021). Thus, transformation processes received a remarkable push (Dwivedi et al., 2020). Existing course designs had to be changed with short lead-time to a distance-only setting to minimize physical meetings and at the same time continue the education. Institutions needed to apply alternative ways to offer services under contact restrictions. This abrupt change included altered digital communication (García-Morales et al., 2021).

An enforced DT is not free of obstacles (Marinoni, van't Land, & Jensen, 2020). Previously to the Covid-19 pandemic, hinders regarding an optimal integration and alignment of digital content and technologies existed (Reid, 2014a). Organizational processes and biases amongst the staff hindered DTs. These obstacles hinder or challenges are called barriers to DT. They are defined as "those things that hinder, slow down, or stop the DT process" (Vogelsang, Liere-Netheler, Packmohr, & Hoppe, 2019).

During the summer term of 2021, one of the authors held a digitally enforced course on Business Informatics (BM106) at the Turkish-German University in Beykoz/Istanbul. The course was part of the study program Master in Business Management (120 ECTS). This program is offered to students who are working. Thus, students attend lectures on evenings and weekends. Sixteen students joined the course. Especially, as these students were working and were affected by the pandemic, they must deal with digital barriers in their workplaces and in their studies. Therefore, the course was conducted with a research-based learning (RBL) design to enhance its value and students' engagement. Within the research-based course design, we addressed barriers to DT in companies. This,

to overcome barriers in the digitally enforced education. Thus, this study will answer the following two research questions:

- Which research results did students generate regarding barriers to DT?
- How did students perceive research-based learning throughout a digitally enforced course setting?

The following structure is applied to answer these research questions: A review of the concepts of barriers to DT and RBL will be described in the following chapter. After, the Methods will present background on different data collections done. The Findings section will introduce the results. The paper will close with a Discussion and Conclusion.

CONCEPTS

Barriers to DT

Vial (2019, p. 121) defines DT as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies." Reis et al. (2018) add that DT takes place through three major elements operations, business model, and customer contact.

IT-Enabled Organizational Transformation (ITOT) is a term connected to DT. The difference is that DT is a concept looking upon the induction of a new organizational identity. This is because digital technologies reformat an organization's business model and customer contact. In an ITOT, digital technology supports existing business models leading to an alignment with the organization (Wessel, Baiyere, Ologeanu-Taddei, Cha, & Blegind Jensen, 2021). Thus, DT is more complex than ITOT and requires a wider approach. DT "changes business elements, including strategy, business model, business processes, organizational structures, and organizational culture" (Vukšić, Ivančić, & Vugec, 2018, p. 737). Hanelt et al. (2021) present a multidimensional framework of DT, which links contextual conditions, mechanisms, and outcomes. Contextual conditions are in- and external triggers, influencing mechanisms within an organization. Further, the mechanisms provoke outcomes for the organization and other stakeholders (Hanelt et al., 2021). Especially within the mechanisms, barriers occur.

DT is a challenge for organizations and needs adequate attention from the management (Pabst von Ohain, 2019). Barriers in DT stem from inconsistencies in interweaving physical with digital layers (Hanelt, Piccinini, Gregory, Hildebrandt, & Kolbe, 2015). Close monitoring of a DT's barriers is mandatory, as they potentially slow down or stop the DT process (Vogelsang, Liere-Netheler, et al., 2019). The roots of barrier research stem from the field of innovation (Piatier, 1984). In DT research, barriers are often associated with a specific technology or stakeholder and are described as simple lists (Akram, 2018). E.g., Bilgeri and Wortmann (2017) set up a list of barriers that interfere with the usage of Internet of Things technology. More rarely, researchers develop barrier classifications in socio-technical settings. Some researchers aggregated single barriers into clusters (Demirbas, Hussain, & Matlay, 2011; Madrid-Guijarro, Garcia, & Van Auken, 2009). Within these clusters, organizational aspects are profoundly represented. Interestingly, technical aspects are less present (Jones, Hutcheson, & Camba, 2021).

The distinction between internal and external views is a pattern within barrier classifications. Internal classifications represent obstacles associated with resources and supply, culture, and people, time, and IT systems. Also, management issues, such as strategy and organization, were represented (Henriette, Feki, & Boughzala, 2016). Barriers are used as a concept to develop technology-enhanced business models (Chesbrough, 2010; Dremel, 2017).

Often, an approach in strategy development is to focus on facilitators such as strengths and opportunities to gain a competitive advantage (Helms & Nixon, 2010). For barriers, the procedure is more complex. The key is to create capabilities (Aguiar, Bogea Gomes, Rupino da Cunha, & Mira da Silva, 2019) that tackle the barriers, help to overcome them, and turn them into supportive aspects. This way, corporations can derive a competitive advantage from barriers. As DT is ubiquitous and complex, an explorative approach seems appropriate. Barriers and facilitators are connected to each other, as their natures are conditional. If conditions change, barriers may turn into facilitators and vice versa (Hadjimanolis, 2003). Thus, research on both concepts is of importance to fully understand the evolution of DT processes.

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The general insights form barriers to DT apply in the context of Higher Education, too. HEIs increasingly use digital technology and distribute information assets by using ubiquitous connectivity (Laurell, Sandström, Eriksson, & Nykvist, 2019). Lectures are conducted using these information assets. Electronic resources are auxiliating the instruction as they can enrich lectures and open for new concepts such as the flipped classroom. Furthermore, digital technology helps in conducting evaluations and implementing measurements such as student engagement (Vogelsang, Droit, & Liere-Netheler, 2019).

Also, in HE, DT is more than just the usage of digital technologies for teaching. Generated data, e.g., data on students, is more available and thus more traceable. Hypothetically, faculty and administration could easily share student records. Even universities face increasing competition. Digitalized processes are supposed to be faster and cheaper. The application of digital technologies results in a variety of digitally-enabled communication forms between students and instructors ranging from 1:1 to 1:many in massive open online courses (Whitaker, New, & Ireland, 2016). DT enriches the possibilities for novel learning designs such as adding channels and digital forms of content. By add-ons, traditional lectures have been enhanced towards blended learning environments or even towards a complete digital learning design. New designs potentially increase learning habits and change mindsets towards learning (Arbaugh, 2014). Nevertheless, obstacles to the adoption and application of digital learning designs endure (Reid, 2014b; Smuts, Lalitha, & Khan, 2017). Excessive costs and time consumption for the high-quality digital content of lectures hinder the adoption. Organizational interfaces between study programs and administration influence the DT process. Technical barriers such as the availability and the application of digital technologies are issues for HEIs, affecting the integration of Learning-Management Systems with administrative systems (Reid, 2014b).

Often, research on DT in HE examines specific learning settings together with their challenges and gains. Researchers are active within three streams with a focus on DT. Students' technology acceptance (Irons, Keel, & Bielema, 2002) and impact on students' learning outcomes characterize the first stream (Janson, Söllner, Bitzer, & Leimeister, 2014). Research on instructional design in relation to DT and its adoption is the second stream (Scherer, Siddiq, & Tondeur, 2019). Organizational obstacles within HEIs (Abrahams, 2010; Porter, Graham, Bodily, & Sandberg, 2016) are in the focus of the third stream. The latter obstacles fuel resistance to change within institutions (Al-Senaidi, Lin, & Poirot, 2009) because stakeholders fear additional workload (Gregory & Lodge, 2015), experience lack of institutional support (Al-Senaidi et al., 2009; Porter et al., 2016), and miss resources in the form of technology and time. Also, DT has an impact on curricula. Thus, faculty tends to be critical stakeholders to consent to these changes (Burch & Mohammed, 2019). Furthermore, external barriers in relation to DT exist, which hinder the development of HE. A globalized environment with increased competition is forcing HEIs to adapt. However, HEIs are often slow in adapting to change (Burch & Mohammed, 2019). A broader perspective with further dimensions is needed to evaluate the students' perception of DT in HE (Vogelsang, Brink, & Packmohr, 2020).

The recent pandemic is impacting research on HEI and DT, as a lot of HEIs were forced to switch to distance teaching with no lead time. Through this lens, Marinoni et al. (2020) found obstacles in communicative interaction, shortage of assets, and coordination difficulties between educational and research duties. Gonzalez et al. (2020) reported a higher study efficiency and more permanent studying habits by comparing longitudinal data. Other studies compared Pre- and Intra-Covid data sets and found a broader spread in the perception of barriers (Packmohr & Brink, 2021a) and lower explanatory power in the Covid-related data (Packmohr & Brink, 2021b).

Research-based learning

There are high expectations for RBL within education. It is expected to train students to be able to deal with the complex challenges of the 21st Century (Willison & O'Regan, 2007). Different terms exist in the realm of research-based learning (RBL), such as inquiry-based learning, research-oriented learning, and research-as-learning. Often, these terms are seen as synonyms to each other. Other related instructional concepts are problem-based learning and challenge-based learning. All approaches aim at encouraging students to engage with relevant questions and problems by researching them to find answers and solutions. RBL is defined as an instructional approach to actively involve students in the process of inquiry. Different classes of instruction exist within the teaching-research nexus (TRN) along the dimensions of content vs. process and audience vs. participants. The RBL approach focuses on the combination of involving students as participants in the research process. The

contrary is the research-led approach, in which the students are the audience who gets the research content presented (Healy, 2005). Ifenthaler and Gosper (2014) distinguish three types of RBL ranging from individual learning interests to engaging with the research community.

Generally, a research cycle contains the seven phases discover the research problems, immerse in theory, generate research questions, develop research methodology, conduct research, analyze and interpret data, implement findings. Each phase targets specific research skills the students are supposed to develop (Camacho, Valcke, & Chiluiza, 2017). These skills match higher-order cognitive processes such as being able to analyze, evaluate, and create (Anderson & Krathwohl, 2002). Most research on RBL has been done on the analyzing and interpreting phase (Camacho et al., 2017).

Advantages of RBL are manyfold and concern the training of learning objectives such as the abilities to formulate research questions, to test the questions, to present results, and to follow research integrity (Wagner, 2014). RBL fosters transferable skills such as critical analysis, group work, time management, text writing, and data handling (Jenkins, Blackman, Lindsay, & Paton-Saltzberg, 1998).

The drawbacks of RBL are the high demand for time. Usually, an engagement with a research topic takes one to two semesters (Camacho et al., 2017). Indicating that whole curricula should implement an RBL approach spanning different courses and semesters with progression (Healy, 2005). RBL requires a match between the content of courses and instructors' research competencies. This makes staffing a major issue. Depending on the research domain, extensive equipment and resources might be needed. Thus, RBL is still implemented only sporadically (Willison & O'Regan, 2007).

METHOD

According to the two-sided research question, this study uses several methods for data collection. The first paragraph revises the RBL data collection conducted by the students. The second section revises the data collection conducted on the students.

RBL data collection by the students

Based on a pre-study with 46 semi-structured interviews, the authors developed a quantitative instrument. For the pre-study, corporate DT experts served as interviewees. A narrative-oriented manual to determine the interviewees' perceptions on the general DT status and the barriers to DT (Vogelsang, Liere-Netheler, et al., 2019). The pre-study sample was collected using a purposive sampling method (Creswell, 2015) recruiting participants via personal networks and professional network sites in various positions. The 46 interviewees joined from 31 enterprises with a focus on the manufacturing, engineering, plastics, and steel sector. Through different rounds of analyzes, the authors deduced the dimensions missing skills, individual, organizational, external, and technical barriers, including a conceptual model of their hypothetical connections with the overall DT process. To measure each of the five barrier dimensions, the authors used 21 characteristics to describe and 36 items to measure the dimension on a five-point Likert scale. To prevent bias by only asking about barriers with a negative connotation, the authors positively formulated 18 items (Brink, Packmohr, & Vogelsang, 2020). The development process of the instrument is oriented towards the validation procedure postulated by MacKenzie et al. (2011). Originally, the instrument was developed to survey engineering enterprises as they experience a special form of DT called Industry 4.0 (Brink & Packmohr, 2022). After, it was broadened to fit other industries. German and English versions of the instrument are hosted on the LimeSurvey account of Osnabrück University.

During the course BM106, the instructor introduced the students to the concept of DT, to research barriers to DT, and to the qualitative instrument. It was found that the topic is a good fit for the lectures running in parallel and being based mainly on the textbook Management Information Systems: Managing the Digital Firm (Laudon & Laudon, 2020). The textbook explicitly takes up the term DT and elements of DT such as process effectivity and customer intimacy.

The first task for the students was to translate the instrument into the Turkish language. After, the new language version was hosted at Osnabrück University, too. Several survey links were generated and given to the students, who assembled groups of three. The second task, which served as the mid-term assignment, was to promote the survey links via personal networks and professional network sites. The promotion needed to be documented and

presented. After the survey period, the student groups got their collected data back and were asked to analyze the data, document the results, and present them within a project assignment.

Data collection from the students

In parallel with the above qualitative instrument targeted towards private corporations, the authors developed a similar questionnaire to survey students' perception of the DT of their HEI (Vogelsang et al., 2020). For the development of the HEI instrument, the same dimensions were used. The items were adapted towards a setting within HE. Especially students with work experience are an interesting group to survey, as they might be born as digital natives and experienced digital barriers at work and within HEI. Also, they will be future decision-makers to shape DT processes. Another questionnaire to evaluate the course, in general, was distributed in which the students were allowed to add free texts. Additional qualitative data to support the quantitative findings can be derived from the assignment documentation.

FINDINGS

RBL results

To analyze the RBL data collection of the students, the authors aggregated the data of the study groups into one data set. The sample consists of 279 valid cases. Out of the total of 285 participants, six were classified as invalid. Mainly Turkish speaking participants participated in the survey. Most of the participants (57) stem from the finance and insurance industry. The sample includes 83 participants with leadership responsibility. The majority (112 participants) works in companies with more than 1000 employees. The age group most represented in the sample is 20-30 with 127 participants.

The descriptive statistics in table 1 show values around and above the middle of the 5-point Likert scale. The DT Process itself was more perceived towards the higher side of the scale with a mean value of 3.62. Also, the standard deviation is rather high on this dimension. From the barriers, the missing skills show the highest mean value of 3.28 with a rather low standard deviation of 0,57 compared to the other dimensions. Table 1 shows the results of the correlation analysis, too. Nearly all p-values are significant. In correlation to the DT Process, the coefficients of the barriers are negative. These results were hypothetically expected, as barriers, due to their definition, influence the DT process negatively. All barrier dimensions are positively correlated with each other. The organizational dimension shows the highest negative correlation with the DT process. The Cronbach's Alpha measures the internal consistency of the dimensions to analyze how well the items fit in their respective dimensions. Results indicate a good consistency for the DT Process (0,81) and the organizational dimension of the barriers (0,84).

Table 1. Descriptive Statistics and Correlations of the industry sample

Descriptive Statistics					Spearman's Correlation Matrix						Cronbach's Alpha
Dimension	Minimum	Maximum	Mean	Std.Dev.	DT Process	Individual	Organizational	Technical	External	Missing Skills	
DT Process	1,00	5,00	3,62	,75	1,00						,81
Individual	1,00	3,86	2,42	,53	-,26**	1,00					,62
Organizational	1,00	5,00	2,35	,72	-,71**	,31**	1,00				,84
Technical	1,00	5,00	3,08	,60	-,46**	,26**	,46**	1,00			,60
External	1,00	5,00	2,87	,60	-,29**	,25**	,44**	,33**	1,00		,55
Missing Skills	1,17	5,00	3,28	,57	-,47**	,12	,50**	,48**	,41**	1,00	,68
*p < 0.05 significant, **p< 0.01 significant											

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The results of the regression analysis are shown in table 2. The organizational dimension shows the highest negative impact on the DT Process (-0,731). Surprisingly, the coefficient of the external barriers shows a positive result (0,148), which means a higher barrier would lead to an increased DT process. Four out of five dimensions are significant at a 0,05 level. The individual barrier shows an insignificant result. Furthermore, its impact on the DT process is rather low. The adjusted R^2 shows an explanatory power of the barriers on the DT Process of 0,648.

Table 2. Regression (DT Process as dependent variable) of the industry sample

Indep. variables	Coefficient	Sig.
Intercept	5,884	,000
Ind.	-,006	,911
Orga.	-,731	,000
Tec.	-,169	,006
Ext.	,148	,008
Skills	-,134	,035
R^2	,655	
Adjusted R^2	,648	

RBL perception

In total, 14 students were active in the course BM106 Business Informatics. As this is a rather limited number of potential respondents, the following results will be descriptive.

The authors used a questionnaire on barriers to HEI, which was derived from the barriers questionnaire which the students used to collect RBL data. Out of the 14 students, 12 participated in the questionnaire. In total, three female students joined the course. Only one participated in this questionnaire. The 11 remaining participants were male. The age ranges from 24 to 47. The DT Process has the highest mean and the highest standard deviation. Meaning the perception of participants is rather spread out. The values of the other dimensions orient towards the lower half of the Likert scale. Thus, the barriers are perceived as less hindering. Here, all dimensions are negatively correlated with the DT process, too. Because of the small number of participants, p-values are less significant and Cronbach's Alpha lower.

Table 3. Descriptive Statistics and Correlations of the HEI sample

Descriptive Statistics					Spearman's Correlation Matrix						Cronbach's Alpha
Dimension	Minimum	Maximum	Mean	Std.Dev.	DT Process	Individual	Organizational	Technical	External	Missing Skills	
DT Process	2,25	5,00	3,71	,77	1,00						,72
Individual	1,50	3,33	2,33	,49	-,56	1,00					,30
Organizational	1,29	3,57	2,38	,67	-,75**	,40	1,00				,70
Technical	1,25	2,50	1,83	,39	-,29	,69*	-,01	1,00			,19
External	2,00	3,50	2,63	,51	-,09	,37	,02	,14	1,00		,21
Missing Skills	1,50	3,50	2,43	,68	-,36	,48	,60*	,37	,28	1,00	,73
*p < 0.05 significant, **p< 0.01 significant											

Table 4 represents the correlation analysis for the HEI sample. The organizational barriers have the soundest significant impact on the DT Process. These results are in line with findings from other studies (Packmohr & Brink, 2021b). Other values deviate from previous studies due to the low amount of respondents.

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Table 4. Regression (DT Process as dependent variable) of the HEI sample

Indep. variables	Coefficient	Sig.
Intercept	7,349	
Ind.	-,363	,543
Orga.	-1,055	,021
Tec.	-,690	,301
Ext.	-,029	,930
Skills	,436	,160
R^2	,850	
Adjusted R^2	,726	

Besides the HEI questionnaire, students of BM106 were asked to fill in a course evaluation with questions were related to the lectures and to the RBL experience. Items were measured on a 5-point Likert scale. Out of 14 students, ten participated in the evaluation. Table 4 presents the RBL related questions with their means and standard deviations. In general, the perception of the influence of technology on the learning process results in a mean of 3,80 with a rather high standard deviation of 1,03. The means of the more RBL related questions show high means and lower standard deviations.

Table 5. Closed questions of the course evaluation

Question	Mean	Std.Dev.
The technology used due to Covid-19 (Google Classroom) supported my understanding of the content in the same way as it had been in the classroom.	3,80	1,03
Students were encouraged to participate in class discussions.	4,80	0,42
Overall, I made progress in understanding the content.	4,60	0,70
Overall, I developed a more critical approach to thinking on the topic of the course.	4,60	0,70

Table 6 lists the original answers to the open-ended questions. As they are rather short, they were not coded. Students appreciated the real-life experience, such as connecting to the experience of a future thesis. The students stated that promoting the questionnaire was hard. Otherwise, the analysis was perceived as the more enjoyable part.

Table 6. Open question of the course evaluation

Resp.	How did you like the project (promoting the questionnaire, collecting data, and analyzing it)?
1	It was very good
2	I really liked it; I had a real-life example, thanks to you.
3	(Not answered)
4	It was hard to collect data from our social environment, but in the end, I enjoyed the analyzing part of it.
5	Analyzing is a gift for me. Because collecting data is usually hard.
6	Very liked
7	It is effective to understand the whole process flow and analysis methodologies in a simple way.
8	It was a good opportunity to work as a team on such a questionnaire. Promoting part was not easy, but we tried our best to get the most of the available responses.
9	I think transformation has not been done yet for most businesses. Thus the result was not clear and descriptive.
10	It was a great opportunity to prepare ourselves for the master thesis.

Looking at the submitted assignments as qualitative data, students seemed very engaged. To promote the questionnaire, students sent it out on their Linked-In profiles, in chat groups from their graduate studies, and tried to contact specific companies and chambers of commerce. In analysis, students were asked to calculate descriptive statistics and conduct a regression analysis. Some added features like correlation or spider-webs to visualize their results.

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DISCUSSION AND CONCLUSIONS

The results of the data collected by the students of BM106 with an RBL approach show a high explanatory power for the barriers influencing the DT Process. Most of the barriers show a significant impact. The results of the descriptive statistics lean towards lower barrier perceptions. Most respondents indicated they work within Finance and Insurance. As Finance and Insurance is an industry with a rather high degree of digitalization (Bughin et al., 2016), the perception of barriers might be lower and more homogenous. Still, the coefficient of the external barrier dimension shows an unexpected result in the regression analysis. It shows the characteristics of a driver. Items on laws and regulations are included in the dimension of external barriers. Finance and insurance is a strongly regulated sector. As regulations change slower than technological advancements, they hypothetically can hinder the DT process. In our correlation analysis, the external dimension of the barriers and the DT Process are correlated negatively. The regression proposes a one-directional cause-and-effect relationship. There might be push and pull in both directions. New regulations push for new technologies, and new technologies pull for new regulations, similar to the market and technology push-pull model (Lichtenthaler, 2020).

From the data on the barriers to DT in HE, students perceive barriers in general as low. Compared to other studies, in which higher means were present (Packmohr & Brink, 2021b). Especially, technical barriers do not seem to harm the students' studies. Although, it needs to be added that some students had an engineering background and all of them had prior work experience. Thus, they might be more tech-savvy and have a positive attitude towards technology. Finally, the evaluation of the RBL approach signals that students positively engage with the research topic. In this case, there is an appropriate overlap between the course content and the research conducted. Calls for integration in whole curricula exist (Healy, 2005) but are hard to pursue. Also, the current RBL approach is the most basic one (Willison & O'Regan, 2007), in which students receive a lot of guidance. An approach on a higher independent level might generate engagement as well but opens for the risk of feeling unsupervised.

Limitations of this study are its basic RBL approach and its limited amount of participants within the student sample. Future work should aim to broaden the student sample. Also, more sophisticated instruments to measure student engagement might be applied by using pre- and post-test designs (Mandernach, 2015). By applying a standardized instrument, comparisons between different disciplines can be understood more in-depth. Still, the topic of the course surveyed in this study is at the crossroads of technology and social sciences.

In conclusion, students collected data on barriers to DT, providing a high adjusted R^2 on a hypothetical model tested by regression. RBL is a good approach for teaching under pandemic circumstances. Students can engage in analyzing research data. Collecting the data, especially in a pandemic, is a more complicated task. A web-based questionnaire and professional social media channels can help in generating the research data.

REFERENCES

Abrahams, D. A. (2010). Technology adoption in Higher Education: A framework for identifying and prioritising issues and barriers to adoption of instructional technology. Journal of Applied Research in Higher Education, 2, 34–49.

Aguiar, T., Bogea Gomes, S., Rupino da Cunha, P., & Mira da Silva, M. (2019). Digital Transformation Capability Maturity Model Framework. 2019 IEEE 23rd International Enterprise Distributed Object Computing Conference (EDOC), 51–57. Paris, France: IEEE.

Akram, M. S. (2018). Drivers and barriers to online shopping in a newly digitalized society. TEM Journal, 7, 118–127.

Al-Senaidi, S., Lin, L., & Poirot, J. (2009). Barriers to adopting technology for teaching and learning in Oman. Computers & Education, 53, 575–590.

Anderson, L. W., & Krathwohl, D. R. (Eds.). (2002). A taxonomy for learning, teaching, and assessing: A revision of Bloom's taxonomy of educational objectives. Allyn & Bacon.

Arbaugh, J. B. (2014). What Might Online Delivery Teach Us About Blended Management Education? Prior Perspectives and Future Directions. Journal of Management Education, 38, 784–817.

Bilgeri, D., & Wortmann, F. (2017). Barriers to IoT Business Model Innovation. Proceedings of the 13th International Conference on Wirtschaftsinformatik, 987–990.

Authors' pre-published version; The final authenticated version is available at 10.3726/b19802.

Brink, H., & Packmohr, S. (2022). Analyzing Barriers to Digital Transformation in the German Engineering Industry – A Comparison of Digitalized and Non-Digitalized Enterprises. Proceedings of the 55th Hawaii International Conference on System Sciences, 4849–4858. Hawaii, USA.

Brink, H., Packmohr, S., & Vogelsang, K. (2020). Developing and Applying an Instrument to Measure Barriers to Digital Transformation: A Mixed-Method Study. Presented at the 33th Eurasia Business and Economics Society Conference, Madrid.

Bughin, J., Hazan, E., Labaye, E., Manyika, J., Dahlström, P., Ramaswamy, S., & Cochin de Billy, C. (2016). DIGITAL EUROPE: PUSHING THE FRONTIER, CAPTURING THE BENEFITS. New York: McKinsey Global Institute.

Burch, Z. A., & Mohammed, S. (2019). Exploring Faculty Perceptions about Classroom Technology Integration and Acceptance: A Literature Review. International Journal of Research in Education and Science, 5, 722–729.

Camacho, M. H., Valcke, M., & Chiluiza, K. (2017, March). RESEARCH BASED LEARNING IN HIGHER EDUCATION: A REVIEW OF LITERATURE. 4188–4197. Valencia, Spain.

Castro, R. (2019). Blended learning in higher education: Trends and capabilities. Education and Information Technologies, 24, 2523–2546.

Chesbrough, H. (2010). Business Model Innovation: Opportunities and Barriers. Long Range Planning, 43, 354–363.

Creswell, J. W. (2015). A concise introduction to mixed methods research. Los Angeles: SAGE.

Demirbas, D., Hussain, J. G., & Matlay, H. (2011). Owner-managers' perceptions of barriers to innovation: Empirical evidence from Turkish SMEs. Journal of Small Business and Enterprise Development, 18, 764–780.

Dremel, C. (2017). Barriers to the adoption of big data analytics in the automotive sector. Proceedings of the 23rd American Conference on Information Systems (AMCIS), 1–10. Boston.

Dwivedi. (2018). Digitizing Academic Delivery in Higher Education Issues and Challenges. 2018 5th International Symposium on Emerging Trends and Technologies in Libraries and Information Services (ETTLIS), 179–182. Noida: IEEE.

Dwivedi, Hughes, D. L., Coombs, C., Constantiou, I., Duan, Y., Edwards, J. S., … Upadhyay, N. (2020). Impact of COVID-19 pandemic on information management research and practice: Transforming education, work and life. International Journal of Information Management, 55, 102211.

Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2013). Embracing digital technology: A new strategic imperative. MIT Sloan Management Review, 55, 1–12.

García-Morales, V. J., Garrido-Moreno, A., & Martín-Rojas, R. (2021). The Transformation of Higher Education After the COVID Disruption: Emerging Challenges in an Online Learning Scenario. Frontiers in Psychology, 0. https://doi.org/10.3389/fpsyg.2021.616059

Gonzalez, T., de la Rubia, M. A., Hincz, K. P., Comas-Lopez, M., Subirats, L., Fort, S., & Sacha, G. M. (2020). Influence of COVID-19 confinement on students' performance in higher education. PLOS ONE, 15, e0239490.

Gregory, M. S.-J., & Lodge, J. M. (2015). Academic workload: The silent barrier to the implementation of technology-enhanced learning strategies in higher education. Distance Education, 36, 210–230.

Hadjimanolis, A. (2003). The Barriers Approach to Innovation. In L. V. Shavinina (Ed.), The International Handbook on Innovation (pp. 559–573). Oxford: Pergamon.

Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2021). A Systematic Review of the Literature on Digital Transformation: Insights and Implications for Strategy and Organizational Change. Journal of Management Studies, 58, 1159–1197.

Hanelt, A., Piccinini, E., Gregory, R. W., Hildebrandt, B., & Kolbe, L. M. (2015). Digital Transformation of Primarily Physical Industries-Exploring the Impact of Digital Trends on Business Models of Automobile Manufacturers. Wirtschaftsinformatik, 1313–1327.

Healy, M. (2005). Linking research and teaching exploring disciplinary spaces and the role of inquiry-based learning. In R. Barnett (Ed.), Reshaping the university: New relationships between research, scholarship and teaching (pp. 67–78). Berkshire: McGraw-Hill.

Helms, M. M., & Nixon, J. (2010). Exploring SWOT analysis – where are we now? A review of academic research from the last decade. Journal of Strategy and Management, 3, 215–251.

Henriette, E., Feki, M., & Boughzala, I. (2016). Digital Transformation Challenges. Mediterranean Conference on Information Systems (MICS), 1–7.

Ifenthaler, D., & Gosper, M. (2014). Research-Based Learning: Connecting Research and Instruction. In M. Gosper & D. Ifenthaler (Eds.), Curriculum Models for the 21st Century (pp. 73–89). New York, NY: Springer New York.

Irons, L. R., Keel, R., & Bielema, C. L. (2002). Blended Learning and Learner Satisfaction: Keys to User Acceptance? USDLA Journal, 16.

Janson, A., Söllner, M., Bitzer, P., & Leimeister, J. M. (2014). Examining the effect of different measurements of learning success in technology-mediated learning research. 35th International Conference on Information Systems (ICIS), 1–10.

Jenkins, A., Blackman, T., Lindsay, R., & Paton-Saltzberg, R. (1998). Teaching and research: Student perspectives and policy implications. Studies in Higher Education, 23, 127–141.

Jones, M. D., Hutcheson, S., & Camba, J. D. (2021). Past, present, and future barriers to digital transformation in manufacturing: A review. Journal of Manufacturing Systems, 60, 936–948.

Laudon, K. C., & Laudon, J. P. (2020). Management information systems: Managing the digital firm (Sixteenth edition). New York, NY: Pearson.

Laurell, C., Sandström, C., Eriksson, K., & Nykvist, R. (2019). Digitalization and the future of Management Learning: New technology as an enabler of historical, practice-oriented, and critical perspectives in management research and learning. Management Learning, 51, 1350507619872912.

Lichtenthaler, U. (2020). Building Blocks of Successful Digital Transformation: Complementing Technology and Market Issues. International Journal of Innovation and Technology Management, 17, 2050004.

MacKenzie, S. B., Podsakoff, P. M., & Podsakoff, N. P. (2011). Construct Measurement and Validation Procedures in MIS and Behavioral Research: Integrating New and Existing Techniques. MIS Quarterly, 35, 293–334.

Madrid-Guijarro, A., Garcia, D., & Van Auken, H. (2009). Barriers to Innovation among Spanish Manufacturing SMEs. Journal of Small Business Management, 47, 465–488.

Mandernach, B. J. (2015). Assessment of student engagement in higher education: A synthesis of literature and assessment tools. International Journal of Learning, Teaching and Educational Research, 12, 1–14.

Marinoni, G., van't Land, H., & Jensen, T. (2020). THE IMPACT OF COVID-19 ON HIGHER EDUCATION AROUND THE WORLD. Paris: International Association of Universities.

Pabst von Ohain, B. (2019). Leader Attributes for Successful Digital Transformation. ICIS 2019 Proceedings. Retrieved from https://aisel.aisnet.org/icis2019/practice_is_research/practice_is_research/5

Packmohr, S., & Brink, H. (2021a). Comparing Pre- and Intra-Covid-19 students' perception of the digitalization of higher education institutions. 7th International Conference on Higher Education Advances (HEAd'21). Presented at the Seventh International Conference on Higher Education Advances.

Packmohr, S., & Brink, H. (2021b). Impact of the Pandemic on the Barriers to the Digital Transformation in Higher Education—Comparing Pre- and Intra-Covid-19 Perceptions of Management Students. In R. A. Buchmann, A. Polini, B. Johansson, & D. Karagiannis (Eds.), Perspectives in Business Informatics Research (pp. 3–18). Cham: Springer International Publishing.

Piatier, A. (1984). Barriers to innovation. London; Dover, N.H: F. Pinter.

Porter, W. W., Graham, C. R., Bodily, R. G., & Sandberg, D. S. (2016). A qualitative analysis of institutional drivers and barriers to blended learning adoption in higher education. The Internet and Higher Education, 28, 17–27.

Reid, P. (2014a). Categories for barriers to adoption of instructional technologies. Education and Information Technologies, 19, 383–407.

Reid, P. (2014b). Categories for barriers to adoption of instructional technologies. Education and Information Technologies, 19, 383–407.

Reis, J., Amorim, M., Melão, N., & Matos, P. (2018). Digital Transformation: A Literature Review and Guidelines for Future Research. In Á. Rocha, H. Adeli, L. P. Reis, & S. Costanzo (Eds.), Trends and Advances in Information Systems and Technologies (pp. 411–421). Cham: Springer International Publishing.

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. Computers & Education, 128, 13–35.

Smuts, R. G., Lalitha, V. V. M., & Khan, H. U. (2017). Change Management Guidelines That Address Barriers to Technology Adoption in an HEI Context. 2017 IEEE 7th International Advance Computing Conference (IACC), 754–758.

Vial, G. (2019). Understanding digital transformation: A review and a research agenda. The Journal of Strategic Information Systems, 28, 118–144.

Vogelsang, K., Brink, H., & Packmohr, S. (2020). Measuring the Barriers to the Digital Transformation in Management Courses – A Mixed Methods Study. In R. A. Buchmann, A. Polini, B. Johansson, & D. Karagiannis (Eds.), Perspectives in Business Informatics Research (pp. 19–34). Cham: Springer International Publishing.

Vogelsang, K., Droit, A., & Liere-Netheler, K. (2019). Designing a Flipped Classroom Course–a Process Model. Proceedings of the 14th International Conference on Wirtschaftsinformatik, 345–359.

Vogelsang, K., Liere-Netheler, K., Packmohr, S., & Hoppe, U. (2019). Barriers to Digital Transformation in Manufacturing: Development of a Research Agenda. Proceedings of the 52nd Hawaii International Conference on System Sciences, 4937–4946.

Vukšić, V. B., Ivančić, L., & Vugec, D. S. (2018). A Preliminary Literature Review Of Digital Transformation Case Studies. https://doi.org/10.5281/ZENODO.1474581

Wagner, G. E. (2014). Research-Based Learning. In C. L. Quave (Ed.), Innovative Strategies for Teaching in the Plant Sciences (pp. 61–82). New York, NY: Springer New York.

Wessel, L., Baiyere, A., Ologeanu-Taddei, R., Cha, J., & Blegind Jensen, T. (2021). Unpacking the Difference Between Digital Transformation and IT-Enabled Organizational Transformation. Journal of the Association for Information Systems, 22, 102–129.

Whitaker, J., New, J. R., & Ireland, R. D. (2016). MOOCs and the Online Delivery of Business Education What's new? What's not? What now? Academy of Management Learning & Education, 15, 345–365.

Willison, J., & O'Regan, K. (2007). Commonly known, commonly not known, totally unknown: A framework for students becoming researchers. Higher Education Research & Development, 26, 393–409.