Factors Influencing Digital Transformation Adoption among Higher Education Institutions during Digital Disruption

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Abstract

This research aims to apply confirmatory factor analysis to identify the digital transformation components for higher education institutions. The research sample consisted of 300 personnel from agencies within higher education institutions, which are higher education institutions under the Ministry of Higher Education, Science, Research and Innovation, Thailand that use the database system on educational quality assurance called Commission on Higher Education Quality Assessment online system (CHE QA Online). The selection was the result of multi-stage random sampling from 100 higher education instructions. The research tool was an online questionnaire form on factors influencing the success of information systems in the digital transformation for higher education institutions by 5-level rating scale based on the Likert's scale. The result revealed that digital transformation factor consistent with empirical data (p-value = 0.860), which consist of 6 components: 1) Strategy 2) Process 3) Product/Service 4) People 5) Data) and 6) Technology. The research findings help higher education institutions prepare for the elements necessary for the institutional transformation to a digital organization.

Keywords: digital transformation, higher education institutions, confirmatory factor analysis

1. Introduction

Disruptive Technology has a wide impact on the economy, society, education, and lifestyles of people around the world. The digital transformation due to the use of technology affects various dimensions of the organization, including: 1) Externally with a focus on creating a digital experience for customers 2) Internally that affecting business operations, decision-making and organizational structure, and 3) Holistically, to include all parts and functions of the affected organization. This often leads to a completely new business model. Digital transformation is one of the key challenges for all industries in the past few years (Schuchmann & Seufert, 2015). Organizations that succeed in developing appropriate management and technological skills will benefit from new digital technologies (Fitzgerald et al., 2013).

The internal management of educational institutions has to change rapidly as well. Technology that enables new forms of learning has reduced the reliance on university learning. As a result, many higher education institutions have begun to change the pattern of freedom of knowledge and access to knowledge resources. And support the leaping change of technology and developing digital innovations to society that leads to the transformation of education. Higher education institutions will be at the forefront of the most important of driving change. Therefore, higher education institutions should focus on formulating development strategies in terms of learning management that focuses on developing learners to be innovative creators. Thus, higher education institutions must develop a variety of programmes to meet the needs of the business sector. As a result, the role of instructors in higher education institutions has changed. The management of higher education in the future must focus on changing the whole educational process (Thanachawengsakul, N., & Thanyavinichakul, 2020).

The importance of digital transformation as mentioned above. This is the cause leading to the digital transformation for higher education institutions that pay attention to the application of digital technology in the entire educational management system. This research studies the main factors in the digital transformation for higher education institutions through confirmatory factor analysis. To identify the key internal factors of digital

transformation for higher education institutions using confirmatory factor analysis.

2. Literature Review

2.1 Digital Transformation in Higher Education Institute

Digital Transformation is frequently used to indicate technology, company culture, society, creativity, and extrude management. The digital transformation is more than just the simple adoption of new technology (McDonald & Rowsell-Jones, 2012). For higher education institutions, digital transformation will affect all sectors of the organization, it is not just information technology only. Higher education institutions must connect all digital activities with the overall vision and strategy of the organization (McCusker & Babington, 2015; Sarnok et al., 2019; Sarnok et al., 2020).

There are 6 components: 1) Strategy 2) Process 3) Product/Service 4) Personnel 5) Information and 6) Technology for Digital Transformation. It is the use of new technology with existing corporate resources in new operations to create opportunities and challenges for the organization. (Tungpantong et al., 2021).

A. Strategy

Digital transformation is not based on a single strategy. It includes IT strategies, IS strategies, change management strategies, and business strategies. For a successful transition, the alignment of such strategies is extremely important (Mahmood et al., 2019).

Matt (2015) has proposed digital transformation strategies in industries and companies have four essential elements: 1. Use of technologies 2. Changes in value creation 3. Structural changes and 4. financial aspects.

Digital transformation is a complex endeavor across the organization. Using a systematic approach to digital transformation strategies is essential for success. Managers will need to adjust the dimensions of value creation to the specific requirements of the business model (Hess et al., 2016).
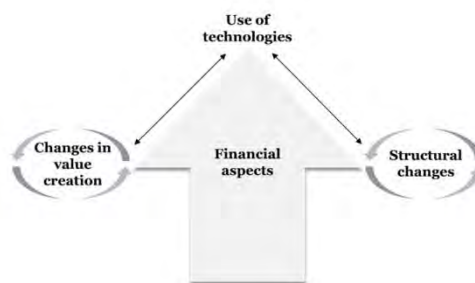

Figure 1. Digital Transformation Framework: Balancing Four Transformational Dimensions (2015)

McCusker and Babington (2015) has proposed a guideline for the successful adoption of digital in universities that universities need to understand digital transformation affects all sectors of the organization. it's not just information technology. The university needs to link all digital activities with the overall vision and strategy of the organization. This is consistent with research by Balyer and Öz (2018) showing that the digital transformation process, managers must first create a vision to generate and managed accordingly for an effective learning environment. Digital transformation depends not only on the use of technology but also on the vision and strategy.

B. Process

Digital transformation describes a shift away from traditional creation and customer value delivery. It includes the operational procedures involved in the use of digital technology with the aim of enhancing or replacing traditional products or services with digital ones. (Sandkuhl & Lehmann, 2017). In the procedure dimension, steps are created, both new and IT operability, utilizing new capabilities for more efficient processes and more efficient integration of traditional processes (Ebert & Duarte, 2018).
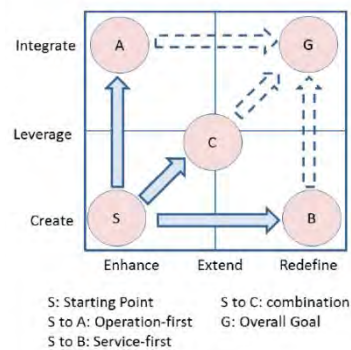
Figure 2. Dimensions of the digital transformation approach (2017)

Key areas in digital transformation, including business models, operational processes, and customer experience, are recognized as key areas of transformation of digital transformation initiatives (George Westerman et al., 2011). It can have an impact on other areas of the organization, such as improving efficiency. Cost savings for both the organization and its customers resulting in added value creation (Morakanyane et al., 2017).

Balyer and Öz (2018) states that for education, the traditional assessment and evaluation methods should be replaced by individual-oriented contemporary assessment and evaluation methods. And Sandkuhl and Lehmann (2017), said that value creation in higher education is everything involved in the student's educational process from admission, programs and courses registration, courses exam, programs development, and quality assurance, etc. It requires integrated campus management functionality including support for mobile workers and for knowledge management.

C. Product/Service

For product or service in education, Sandkuhl and Lehmann (2017), said educational institutions should focus on creating new educational products and turning existing ones into digital products. Opening of educational programs established for external access to higher education institutions at national and international levels. Include distance education in technology practices within the formal education system. This is usually connected to making the content of the education digital and to also providing digital approach for students-teacher and student-student interaction and collaboration (Balyer & Oz, 2018).

Munro (2018) suggests encouraging teachers to reduce their cognitive demands on students and instead focus on entertainment education. It may also improve e-learning flexibility and personalized learning. And digital technologies can provide learning products and services that are universal and accessible but are relevant and appropriate to the needs and preferences of each learner (ELWa, 2003).

D. People

The digital transformation emphasizes organizations with such digital capabilities to change their organizational structure and identity, thus affecting all departments in the organization, roles, responsibilities, and structure (Mahmood et al., 2019).

Not only industry but education is also entering "4.0". The challenge lies in preparing students and staff to cope with the rapid breakthroughs of technologies, new decentralized control paradigms, the growing role of artificial intelligence, a lot of uncertainty, and other ongoing changes (Richert Anja et al., 2016).

The stakeholder should contribute to the digital transformation of educational institutions by giving them access to place and time by supporting technologically appropriate content and infrastructure. Including education administrators and program professionals are ready for this change and are qualified to manage this change. As well as provide positive change for students, teachers, and administrators. It needs to complete the necessary pre-service and in-service training in preparation for the digital transformation (Balyer & Oz, 2018).

E. Data

One of the challenges organizations face in digital transformation is the storage of all of the organization's data, understanding the data collected and available for analysis, indexing data resources and evaluating data quality while searching for opportunities to integrate data resources creates even more challenges. Data are both an opportunity and a problem. Useless data is worthless (Heavin & Power, 2018).

Digitalisierung (2016) noted that on the relationship between technological change and current developments in higher

education , comprehensive data analysis opens new avenues for understanding teaching and learning processes.

The systematic collection and analysis of the accumulated data makes higher education more transparent and comparative. In-depth knowledge of teaching and learning processes can help improve teaching quality and learning conditions.

Maltese (2018) said that digital transformation presents new challenges for universities. Especially, the ability to provide user with complete, up-to-date and consistent information through various communication channels and digital services. It is necessary for universities.

F. Technology

The foundation of digital transformation efforts is digital technology to enable technology to transform organizations. Digital technologies create opportunities that organizations can take advantage of. These opportunities have the potential to chance certain aspects of the organization, especially the business models, operational processes, and customer experiences. As a result, the organization benefits from impacts of this transformation (Morakanyane et al., 2017).

Digital technology has become an essential tool for learning. Within the university context, technologies have gained momentum to the extent that they contribute to the creation of student-centered learning environments (Reigeluth, 2014).

Distance education applications need to be used in digital transformation and face education should be blended with information and communication technologies. It is important that these digital tools to implement digital transformation are essential to learning. It can be provisioned through a central organization or it can be released entirely individually for student's information safety. The active use of information and communication technologies should be encouraged to participate in the classroom environment (Balyer & Oz, 2018). Technology needs to enhance student choice and meet or exceed learners' expectations (Munro, 2018).

3. Research Methodology

3.1 Population and Sample

1) Population

The population scope was personnel from agencies within higher education institutions, which are higher education institutions under the Ministry of Higher Education, Science, Research and Innovation, Thailand.

2) Sample

The sample comprised 300 personnel from agencies within higher education institutions, which are higher education institutions under the Ministry of Higher Education, Science, Research and Innovation, Thailand that use the database system on educational quality assurance or CHE QA Online (Commission on Higher Education Quality Assessment online system). The selection was the result of multi-stage random sampling from 100 higher education instructions. The sample size in this study was determined by the minimum ratio of 10-20 samples per variable (Hair et al., 2014).

3.2 Research Instruments

The research tool was an online questionnaire form on factors influencing the success of information systems in the digital transformation for higher education institutions by 5-level rating scale based on the Likert's scale with a total of 31 questions for 6 components.

The research tool examined the content validity in the questionnaire by 14 experts to verify the accuracy, clarity, and coverage of the research objectives. Its index of item objective congruence (IOC) ranged between 0.71-1.00 with a value greater than 0.5 demonstrating that this research instrument is valid and suitable for the data collection. The researcher created a questionnaire based on questions that had been tested for content validity. The questionnaire was queried to a sample of 30 people and to analyze reliability using Cronbach's Alpha Coefficient statistic of the question is shown in Table 1.

Table 1. Factors and their internal reliability of the scales (2021)

Factor	Acronym	No. of Items	Cronbach's Alpha	Reliability Level [a]
Strategy	DT1	5	0.826	Good
Process	DT2	6	0.878	Good
Product/Service	DT3	5	0.820	Good
People	DT4	5	0.918	Excellent
Data	DT5	5	0.920	Excellent
Technology	DT6	5	0.849	Good
Digital Transformation	*DT*	*31*	*0.947*	*Excellent*

[a] (George, 2011)

4. Result

The data in this study were collected from personnel of agencies within 100 higher education institutions using multi-stage random sampling. A summary of demographic information of those 300 respondents is shown in Table 2. The sample was 54.67% male, 40.67% aged between 31-40 years old, 50.33% master's degree, and 54.33% work experience between 5-15 years.

Table 2. Summary of respondent's demographic Information (2021)

Demographics	Group of Data	Amount	Percentage
Sex	Male	164	54.67
	Female	136	45.33
	Total	*300*	*100.00*
Age	< 30 years old	44	14.67
	31-40 years old	122	4067
	41.50 years old	118	39.33
	> 50 years old	16	5.33
	Total	*300*	*100.00*
Education	Under Bachelor's degree	8	2.67
	Bachelor's degree	97	32.33
	Master's degree	151	50.33
	Ph.D.	44	14.67
	Total	*300*	*100.00*
Work Experience	< 5 years	18	6.00
	5-15 years	163	54.33
	16.25 years	102	34.00
	> 25 years	17	5.67
	Total	*300*	*100.00*

As Table 3 showing the results of the analysis of opinion levels on digital transformation factors of higher education institutions in the aspect of strategy. It was found that the opinion level was at the agree level, the mean was 4.33, the standard deviation was 0.61. In item no.4, Support and drive from the management play a key role in the success, the opinion level was at the strongly agree level. The mean was 4.52 standard deviation was 0.62. For other items, the opinion level was at the agree level with the mean between 4.15 and 4.38.

Table 3. Results of the analysis of opinion level on digital transformation factors of higher education institutions: Strategy (2021)

Item	Mean	S.D.	Interpretation*
Strategy			
1. The strategic vision must be based on the stakeholder's needs.	4.27	0.64	Agree
2. Establish an integrated strategy across the organization in a consistent way.	4.38	0.59	Agree
3. Establish a vision for managing an effective learning environment.	4.15	0.63	Agree
4. Support and drive from the management play a key role in the success.	4.52	0.62	Strongly Agree
5. Determine the right strategy to gain competitive advantage and survive in society.	4.33	0.56	Agree
Total Average	*4.33*	*0.61*	*Agree*

* Legend: 4.50-500 = Strongly Agree; 3.50-4.49 = Agree; 2.50-3.49 = Neutral; 1.51-2.49 = Disagree; 1.00-1.50 = Strongly Disagree

As Table 4 showing the results of the analysis of opinion levels on digital transformation factors of higher education institutions in the aspect of process. It was found that the opinion level was at the agree level, the mean was 4.24, the standard deviation was 0.57. All items had the agree level of opinion, with the mean between 4.17 and 4.32.

Table 4. Results of the analysis of opinion level on digital transformation factors of higher education institutions: Process (2021)

Item	Mean	S.D.	Interpretation*
Process			
6. It is a transformation in operation that is based on the curriculum, teaching style and learner experience.	4.25	0.56	Agree
7. t is an operational transformation that focuses on improving and rebuilding work processes in an integrated digitally managed way.	4.27	0.59	Agree
8. It transforms the entire digital education process from admission, during study, and after graduation.	4.21	0.61	Agree
9. It is a remote operation used in corporate operations for communication and collaboration.	4.32	0.60	Agree
10. It is an operational optimization focused on meeting stakeholder's needs.	4.17	0.52	Agree
11. It increases the efficiency of learning analytics.	4.24	0.56	Agree
Total Average	*4.24*	*0.57*	*Agree*

As Table 5 showing the results of the analysis of opinion levels on digital transformation factors of higher education institutions in the aspect of product/service. It was found that the opinion level was at the agree level, the mean was 4.24, the standard deviation was 0.63. All items had the agree level of opinion, with the mean between 4.17 and 4.33.

Table 5. Results of the analysis of opinion level on digital transformation factors of higher education institutions: Product/Service (2021)

Item	Mean	S.D.	Interpretation*
Product/Service			
12. Create a new digital education which is distance education at both national and international level.	4.21	0.62	Agree
13. Create a new digital education that is responsive and can improve individualized learning.	4.17	0.68	Agree
14. Create new research digitally through national and international collaboration.	4.33	0.63	Agree
15. Digital learning resources stimulate learning and encourage lifelong learning.	4.25	0.57	Agree
16. Digital learning resources encourage marketing to higher education institutions to attract and build awareness.	4.22	0.66	Agree
Total Average	*4.24*	*0.63*	*Agree*

As Table 6 showing the results of the analysis of opinion levels on digital transformation factors of higher education institutions in the aspect of people. It was found that the opinion level was at the agree level, the mean was 4.44, the standard deviation was 0.62. All items had the agree level of opinion, with the mean between 4.37 and 4.48.

Table 6. Results of the analysis of opinion level on digital transformation factors of higher education institutions: People (2021)

Item	Mean	S.D.	Interpretation*
People			
17. It requires skills, acceptance and use of technology by learners, teachers and personnel in the organization.	4.48	0.61	Agree
18. It relies on the mindset and digital culture of the personnel in the organization.	4.46	0.66	Agree
19. It requires close collaboration between the IT personnel and the different departments of the organization.	4.43	0.61	Agree
20. It is important to define the duties and responsibilities of personnel in the digital transformation process.	4.37	0.63	Agree
21. Training on digital technology knowledge and skills development for personnel is essential.	4.48	0.58	Agree
Total Average	*4.44*	*0.62*	*Agree*

As Table 7 showing the results of the analysis of opinion levels on digital transformation factors of higher education institutions in the aspect of data. It was found that the opinion level was at the agree level, the mean was 4.40, the standard deviation was 0.62. All items had the agree level of opinion, with the mean between 4.35 and 4.44.

Table 7. Results of the analysis of opinion level on digital transformation factors of higher education institutions: Data (2021)

Item	Mean	S.D.	Interpretation*
Data			
22. It requires effective management of the diversity, distribution, and quality of data across the organization.	4.38	0.62	Agree
23. It helps to manage the information and knowledge of the organization to achieve goals faster and more efficiently.	4.35	0.61	Agree
24. It helps in analyzing the stored data with high quality and quick access. as well as creating new opportunities and challenges in education management	4.44	0.64	Agree
25. It helps in analyzing the stored data with high quality and quick access. As well as creating new opportunities and challenges in educational management.	4.40	0.63	Agree
26. It helps to collect and analyze data to predict learning behaviors, leading to smarter educational management.	4.43	0.61	Agree
Total Average	*4.40*	*0.62*	*Agree*

As Table 8 showing the results of the analysis of opinion levels on digital transformation factors of higher education institutions in the aspect of technology. It was found that the opinion level was at the agree level, the mean was 4.41, the standard deviation was 0.55. In item no.29,Efficient information technology infrastructure enables digital transformation of quality education. The mean was 4.52 standard deviation was 0.54. For other items, the opinion level was at the agree level with the mean between 4.35 and 4.47.

Table 8. Results of the analysis of opinion level on digital transformation factors of higher education institutions: Technology (2021)

Item	Mean	S.D.	Interpretation*
Technology			
27. Choose digital technologies that are appropriate and aligned with the needs of personnel, courses, services, management of learning environments, and organization's digital transformation goals.	4.47	0.51	Agree
28. Developing infrastructure and technology for a learning environment requires stakeholder characteristics into account.	4.38	0.57	Agree
29. Efficient information technology infrastructure enables digital transformation of quality education.	4.52	0.54	Strongly Agree
30. Using digital technology to create a data-based feedback cycle will lead to new digital innovations.	4.35	0.62	Agree
31. Digital technology facilitates student-centered digital learning.	4.35	0.53	Agree
Total Average	*4.41*	*0.55*	*Agree*

The results of the analysis of opinion levels on digital transformation factors of higher education institutions in 6 components found that 1) Strategy, the opinion level was at the agree level. The mean was 4.33 standard deviation 0.61 2) Process, the opinion level was at the agree level. The mean was 4.24 standard deviation 0.57 3) Products/services, the opinion level was at the agree level. The mean was 4.24 standard deviation 0.63 4) People, the opinion level was at the agree level. The mean was 4.44 standard deviation 0.62 5) Data, the opinion level was at the agree level. The mean was 4.40 standard deviation 0.62 and 6) Technology, the opinion level was at the agree level. The mean was 4.41 standard deviation 0.55.

Table 9. Overall mean score and standard deviation of each factor (2021)

Factor	Mean	S.D.	Skewness	Kurtosis
DT1	4.33	0.61	-0.860	0.907
DT2	4.24	0.57	-0.535	-0.066
DT3	4.24	0.63	-0.592	-0.185
DT4	4.44	0.62	-1.056	0.652
DT5	4.40	0.62	-0.947	0.601
DT6	4.41	0.55	-1.011	0.792

Table 9 indicates that the respondents had similar opinions on the 6 components and were consistent at a high level. The skewness and kurtosis values of the observed variables used in this research were found to be within acceptable criteria that the data had a normal distribution.
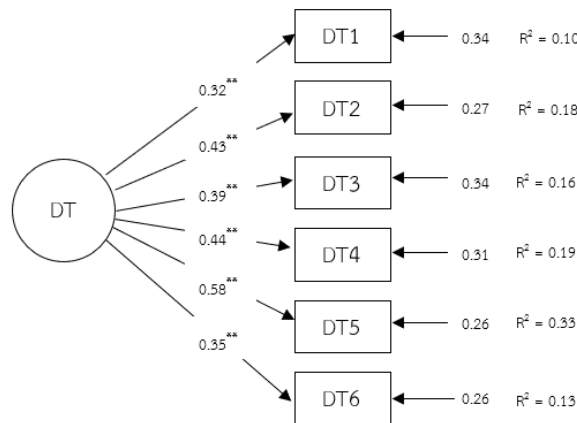

Figure 3. Model diagram of Confirmatory Factor Analysis of digital transformation for Higher Education Institutions (2021)

Chi-square = 4.699, df = 9, p-value = 0.860, CMIN/df = 0.522, GFI = 0.995, AGFI = 0.988, RMSEA = 0.000

** Correlation is significant at the 0.01 level (2-tailed).

Figure 3 showing the analytical results of confirmatory factor analysis revealed that the model was the goodness of fit statistics with the empirical data on digital transformation for higher education institutions. All the goodness of fit statistics passed the criteria. The analysis found that all the observed variables represent the components and were an appropriate composition of digital transformation for higher education institutions.

Table 10. Goodness of fit statistics between the model components and empirical data (2021)

Goodness of fit index	Criteria[a]	Measurement	Interpretation
χ 2-test	p > 0.05	0.860	Pass
χ 2/df	< 2.00	0.522	Pass
GFI	≥ 0.95	0.995	Pass
AGFI	≥ 0.95	0.988	Pass
RMSEA	< 0.05	0.000	Pass

[a] (Muthén & Muthén, 1998; Deborah L. Bandalos, 2018)

Table 10 indicated that all the goodness of fit statistical values between the model components and empirical data passed the criteria. When accounting the χ2-test value which has no statistical significance (p-value = 0.860), χ2/df = 0.522, GFI = 0.995, AGFI = 0.988, and RMSEA = 0.000. It can be concluded that the Figure 3 diagram is positively consistent with the empirical data.

5. Discussion

The confirmatory factor analysis of digital transformation components for higher education institutions demonstrated that the competency component model was consistent with the empirical data. The results showed that the components of digital transformation consist of six elements: 1) Strategy 2) Process 3) Product/Service 4) People 5) Data) and 6) Technology. According to Balyer & Oz (2018) and Munro (2018), the direction of digital technology strategies for higher education must be managed effectively and appropriately. Kopp et al. (2019) showed that digital transformation affects the development of strategies and the implementation of strategies in the transformation process of higher education institutions. Along with Marcelo & Yot-Domínguez (2019), who said that higher education teachers recognize the importance of using digital technology in teaching and learning. Sandkuhl & Lehmann (2017) exploring digital transformation from an organizational perspective of higher education affirms that corporate architecture is an excellent contributor to change planning. In addition, Arnold & Sangrà (2018) noted that organizational changes for technology-enhanced learning in higher education Digital leaders have been instrumental in the success of this transition, with Bervell & Umar (2017) advocating that

higher education leaders and executives should prioritize information infrastructure, digital skills, and training on issues related to digital technology and digital policymaking as well.

6. Conclusion

This research has studied the key internal factors of digital transformation for higher education institutions using confirmatory factor analysis. These factors were identified from previous research and were employed in this study of digital transformation. The results reveal that all the identified factors consist of six elements: 1) Strategy 2) Process 3) Product/Service 4) People 5) Data) and 6) Technology had a significant on digital transformation. Furthermore, organization's data has the highest component weight variable of 0.58. This demonstrates that the data of the organization is the most significant factor in its digital transformation for higher education institution. As a result, businesses must concentrate on data-related procedures and operations such as data collecting, data preparation, data access, data analysis, data storage and data backup in order to stay up with the organization's digital transformation.

References

Arnold, D., & Sangrà, A. (2018). Dawn or dusk of the 5th age of research in educational technology? A literature review on (e-)leadership for technology-enhanced learning in higher education (2013-2017). *International Journal of Educational Technology in Higher Education, 15*(1). https://doi.org/10.1186/s41239-018-0104-3

Balyer, A., & Oz, O. (2018). Academicians' views on digital transformation in education. *International Online Journal of Education and Teaching (IOJET), 5*(4), 809-830.

Bervell, B., & Umar, I. N. (2017). A decade of LMS acceptance and adoption research in Sub-Sahara African higher education: A systematic review of models, methodologies, milestones and main challenges. *Eurasia Journal of Mathematics, Science and Technology Education, 13*(11), 7269-7286. https://doi.org/10.12973/ejmste/79444

Deborah, L. B. (2018). *Measurement Theory and Applications for the Social Sciences* (1st ed.). Guilford Publications.

Digitalisierung, H. (2016). *20 Theses on Digital Teaching and Learning in Higher Education*.

Ebert, C., & Duarte, C. H. C. (2018). Digital Transformation. *IEEE Software, 35*(4), 16-21. https://doi.org/10.1109/MS.2018.2801537

ELWa. (2003). *The context to an e-learning strategy for Wales*. Cardiff: National Council of Education and Training for Wales (ELWa).

Fitzgerald, M., Kruschwitz, N., Bonnet, D., & Welch, M. (2013). Embracing Digital Technology: A New Strategic Imperative | Capgemini Consulting Worldwide. *MIT Sloan Management Review, 55*(1), 1-13.

George, D. (2011). *SPSS for windows step by step: A simple study guide and reference, 17.0 update (10/e)*. Pearson Education India.

George, W., Claire, C., Didier, B., & Patrick, F., & Andrew, M. (2011). Digital Transformation: A roadmap for billion-dollar organizations. *MIT Center for Digital Business and Capgemini Consulting, 1*, 1-68.

Hair, J. F., William, C. B., Barry, J. B., & Rolph, E. A. (2014). *Multivariate Data Analysis* (7th Ed.). Pearson Educat ion Limited. Retrieved from https://www.pearsoned.co.uk

Heavin, C., & Power, D. J. (2018). Challenges for digital transformation-towards a conceptual decision support guide for managers. *Journal of Decision Systems, 27*, 38-45. https://doi.org/10.1080/12460125.2018.1468697

Hess, T., Matt, C., Benlian, A., & Wiesböck, F. (2016). Options for formulating a digital transformation strategy. *MIS Quarterly Executive, 15*(2).

Kopp, M., Gröblinger, O., & Adams, S. (2019). Five Common Assumptions That Prevent Digital Transformation At Higher Education Institutions. *INTED2019 Proceedings, 1*(March), 1448-1457. https://doi.org/10.21125/inted.2019.0445

Mahmood, F., Khan, A. Z., & Khan, M. B. (2019). Digital organizational transformation issues, challenges and impact: A systematic literature review of a decade. *Abasyn Journal of Social Sciences, 12*(2). https://doi.org/10.34091/AJSS.12.2.03

Maltese, V. (2018). Digital transformation challenges for universities: Ensuring information consistency across digital services. *Cataloging and Classification Quarterly, 56*(7), 592-606. https://doi.org/10.1080/01639374.2018.1504847

Marcelo, C., & Yot-Domínguez, C. (2019). From chalk to keyboard in higher education classrooms: changes and coherence when integrating technological knowledge into pedagogical content knowledge. *Journal of Further and Higher Education, 43*(7), 975-988. https://doi.org/10.1080/0309877X.2018.1429584

Matt, C., Hess, T., & Benlian, A. (2015). Digital Transformation Strategies. *Business and Information Systems Engineering, 57*(5), 339-343. https://doi.org/10.1007/s12599-015-0401-5

McCusker, C., & Babington, D. (2015). The 2018 digital university. *Pricewaterhouse Coopers*, 1-20. Retrieved from https://www.pwc.co.uk/assets/pdf/the-2018-digital-university-staying-relevant-in-the-digital-age.pdf

McDonald, M. P., & Rowsell-Jones, A. (2012). *The Digital Edge: Exploiting Information & Technology for Business Advantage*. Gartner, Inc.

Morakanyane, R., Grace, A., & O'Reilly, P. (2017). *Conceptualizing digital transformation in business organizations: A systematic review of literature*. 30th Bled EConference: Digital Transformation - From Connecting Things to Transforming Our Lives, BLED 2017. pp. 427-444. https://doi.org/10.18690/978-961-286-043-1.30

Munro, M. (2018). The complicity of digital technologies in the marketisation of UK higher education: exploring the implications of a critical discourse analysis of thirteen national digital teaching and learning strategies. *International Journal of Educational Technology in Higher Education, 15*(1). https://doi.org/10.1186/s41239-018-0093-2

Muthén, L. K., & Muthén, B. O. (1998). *Mplus: The comprehensive modeling program for applied researchers: user's guide*. Mutheǹ & Mutheǹ.

Reigeluth, C. M. (2014). The Learner-Centered Paradigm of Education: Roles for Technology. *Educational Technology, 54*(3), 18-21.

Richert, A., Shehadeh, M., Willicks, F., & Jeschke, S. (2016). Digital Transformation of Engineering Education - Empirical Insights from Virtual Worlds and Human-Robot-Collaboration. *International Journal of Engineering Pedagogy (iJEP), 6*(4), 23-29. https://doi.org/10.3991/ijep.v6i4.6023

Sandkuhl, K., & Lehmann, H. (2017). *Digital Transformation in higher education-The role of enterprise architectures and portals*. Lecture Notes in Informatics. pp. 12.

Sarnok, K., Wannapiroon, P., & Nilsook, P. (2019). Digital Learning Ecosystem by Using Digital Storytelling for Teacher Profession Students. *International Journal of Information and Education Technology, 9*(1), 21-26. https://doi.org/10.18178/ijiet.2019.9.1.1167

Sarnok, K., Wannapiroon, P., & Nilsook, P. (2020). Dtl-eco system by digital storytelling to develop knowledge and digital intelligence for teacher profession students. *International Journal of Information and Education Technology, 10*(12), 865-872. https://doi.org/10.18178/ijiet.2020.10.12.1472

Schuchmann, D., & Seufert, S. (2015). Corporate Learning in Times of Digital Transformation: A Conceptual Framework and Service Portfolio for the Learning Function in Banking Organisations. *International Journal of Advanced Corporate Learning (IJAC), 8*(1), 31. https://doi.org/10.3991/ijac.v8i1.4440

Thanachawengsakul, N., & Thanyavinichakul, A. (2020). Education Transformation into the Role of Higher Education for Local Development. *Journal of Industrial Education, 19*(3), 131-142.

Tungpantong, C., Nilsook, P., & Wannapiroon, P. (2021). *A Conceptual Framework of Factors for Information Systems Success to Digital Transformation in Higher Education Institutions*. 2021 9th International Conference on Information and Education Technology, ICIET 2021. pp. 57-62. https://doi.org/10.1109/ICIET51873.2021.9419596

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