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Implementation of Digital Transformation in the Technical Higher Education Institutions in Tanzania

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ABSTRACT

Digital transformation has been prioritized recently in this era of fourth industrial revolution by various organizations for maintaining strong competitive advantage, especially in the fourth industrial revolution. The higher education institutions must likewise adopt and implement digital transformation to enrich their students with the knowledge, experience and the skills they need for a very different future. Technical higher education institutions are inevitable in the given transformation. However, very little is known regarding adoption of digital transformation in the given institutions. This study therefore examined the level of adoption of digital services in the technical higher education institutions in Tanzania. It determined the level of awareness of students on digital transformation, opportunity of students to experience digital technologies in teaching-learning process and determining satisfaction level of students on digital teaching-learning environment. This study applied quantitative approach through the cross-sectional survey design. The data were collected using questionnaire from 500 third year (2019/2020) students of two public technical higher education institutions (i.e., Dar es Salaam Institute of Technology and Arusha Technical College). The collected data were analysed using descriptive statistics and t-test. The results indicate that, students from those two institutions had different levels of awareness on digital transformation. Furthermore, the students from both institutions have low opportunity to experience digital technologies in teaching-learning process. Moreover, the students were partly satisfied on the digital teaching-learning environment in the surveyed institutions. The findings of this study advocate the public technical higher education institutions to fully adopt digital transformation for maximally harnessing the opportunities of fourth industrial revolution through their product students.

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INTRODUCTION

Digital transformation (DT) has been prioritized recently in this era of fourth industrial revolution by various organizations for maintaining strong

competitive advantage. It is associated with everyday lives including higher education process (Schwab, 2016). As a country, Tanzania is experiencing a DT instigated by the increasing number of people

connected to communication and internet services. The growing DT is impacting the country's economic and socio-cultural frameworks through enhanced key services and improved productivity in economic sectors (Okeleke, 2016).

Like other organizations, the higher education institutions (HEIs) are likewise inevitable to adopt and implement DT to enrich their students' knowledge, experience and the skills they need for a very different future. The HEIs are thus conventionally envisaged to plan, test and implement innovation including DT (Grosbeck et al., 2020). The DT is shown as the main instrument of providing a vibrant knowledge, skills and attitudes on how digital technologies enhance students' experience in the higher education field (Rampelt et al., 2019). Therefore, the HEIs have been progressively interested in accepting DT in teaching-learning process following the rising number of students using internet services through mobile devices (Santos & Marques, 2019). The DT has been therefore a priority for HEIs in 2nd decade of the 21st century as it was essential for change and for highly competitive environment (Benavides et al., 2020).

Furthermore, the HEIs are currently urged to undergo DT in order to meet present and future demands such as competition, students-centred focus, customer experience and agility, profit, life-long learning, and action-based models (Grosbeck et al., 2020). Additionally, every education institution is insisted to set up the strategy towards DT by considering digital infrastructure, building capacity to academic staff in using digitally-based teaching-learning methods and improvement of students' digital skills (PWC, 2015; Menendez et al., 2016)

DT is defined as a series of deep and coordinated culture, workforce, and technology shifts which enables new educational and operating models and transform an institution's business model, strategic directions, and value proposition

(Pelletier & Hutt, 2021). It is a transformative process which significantly stimulates all activities such as development of new infrastructures, processes, places, formats, objectives, and increasing use of digital media and technologies (e.g. virtual and augmented reality, artificial intelligence, the Internet of Things) in teaching, learning, researching, administration, support services, communication, and working in higher education (Christensen & Eyring 2011; Pucciarelli & Kaplan 2016; McCowan 2017; Curaj et al. 2018; Crittenden et al. 2019; Orr et al. 2019; Zervina & Stukalina 2019; Rampelt et al., 2019).

The DT equally facilitates admitting, enrolling and registering students digitally (using social media, and mobile phones); provide and monitor various online services and teaching-learning services and partnering with the industry for enhancing career opportunities (Grosbeck et al., 2020). It similarly contributes positively in meeting customers' needs through technologies and data in business; and contributes development of novel infrastructures for teaching and learning, research and consultancy services, administration and communication in higher education in meeting the needs of students, staff and community at large (Grosbeck et al., 2020).

The importance of DT has thus attracted several researchers in Tanzania and the world at large. For instance, Mikheev & Vasyaev (2021) analyzed the existing trends in the DT of HEIs. The study recommends that, the HEIs should implement full-fledged online and distance learning courses; introduce students with digital teaching-learning methods; provide open access to electronic resources and research results; participate in global open science ingenuities; and reduce higher education costs through digital instructional planning, delivery and assessment.

In assessing the maturity level of DT in HEIs comparing to other industries, Rodríguez-Abitia & Bribiesca-Correa

(2021) noted that the HEIs react slowly and fall behind other sectors because of poor financial support, ineffective leadership, resistant changes in culture, and insufficient degree of innovation.

Santos & Marques (2019) analyzed the students' perspective on the use of DT technologies in communicating with lecturers; goals and functions of students using DT technologies; and students' expectations in using DT technologies. The study finds that, the DT technologies allowed interpersonal communication between the students; the students preferred DT technologies in communicating with their lecturers; and the students had variation in their about the use ease, expectation, attitude and varied satisfaction in using DT technologies.

Pelletier & Hutt (2021) researched on DT particularly in equipping advisors for the journey, students for success. The given study eventually stresses that, the HEIs need to prepare processes, policies and people in pursuing DT technology for supporting students in achieving their personal, academic, and career goals accordingly.

Technical Higher Education Institutions (THEIs) are one of the HEIs directed to adopt and apply DT in teaching-learning, researching and consulting process. For instance, International Centre for Technical and Vocational Education and Training (UNESCO-UNEVOC) stresses that, THEIs must make best practices of undergoing through DT by integrating technology in curriculum and ensuring provision of adequate education in preparing the learners for the present and future world of work. This means that, the THEIs are advocated to adopt and implement DT to enrich their students with the knowledge, experience and the skills they need for a very different future. In other words, the THEIs are inevitable in the given DT. However, very little is known regarding DT in the given institutions. Specifically, very little is known on DT awareness; opportunity of experiencing DT in

teaching/learning environment; and satisfaction of users on DT in teaching/learning environment. Benavides *et al.*, (2020) stress that, DT is undeniably an evolving field and the HEIs don't develop DT proposals in a holistic dimension hence called for further research efforts on how HEIs apprehend DT with current requirement of the fourth industrial revolution. This study therefore examined the level of adoption of digital services in the THEIs in Tanzania. The study attempted the following:

- i. determined the level of awareness of students on DT in the THEIs
- ii. determined opportunity of students to experience DT in teaching-learning process in the THEIs
- iii. determined satisfaction level of students on digital teaching-learning environment in the THEIs
- iv. determined and compared the Digital Transformation (DT) awareness between the Dar es Salaam Institute of Technology (DIT) students and Arusha Technical College (ATC) students.

METHODS AND MATERIALS

Data for this study were collected from students of DIT and ATC in Tanzania. The institutes were chosen due to their similar operating characteristics and history. They offer almost similar academic programmes and courses including engineering, science and technology. Just like other HEIs, they were expected to undergo DT based on their insistence on technologies in teaching-learning process, research and consultancy. The quantitative approach was applied due to the nature of the specific objectives addressed in this study. The approach facilitated the understanding of the study problem more emphatically by describing and comparing the implementation of DT in the surveyed THEIs in Tanzania. The study adopted survey design with cross-sectional strategy whereby data were collected using questionnaire from third

year students at a single point in time as from March, 2020 to May, 2020. Stratified simple random sampling techniques were used to sample 500 third year (2019/2020) students of the aforementioned two public THEIs.

The collected data were analyzed using descriptive statistics and independent t-test. The Descriptive Statistics was used to analyze the students' personal information, variables for any assumption violation, and t-test for comparing the implementation of DT between the students of the two surveyed THEIs.

The principal variable in this study is DT. It was measured using statement items with categories such as technologies (virtual and augmented reality, artificial intelligence, and the Internet of Things); teaching-learning process (online and distance learning courses, digital teaching-learning methods, open access to electronic resources and research results, digital instructional planning, delivery and assessment); and communication (the use of DT technologies in communicating with lecturers), broadband quality/performance (experienced speeds, latency, reliability and robustness of broadband services), ICT investment (hardware, software and communication infrastructure) as sourced

from previous studies (Christensen & Eyring 2011; Pucciarelli & Kaplan 2016; McCowan 2017; Sperling, 2017; Curaj et al. 2018; Crittenden et al. 2019; Orr et al. 2019; Zervina & Stukalina 2019; Rampelt et al., 2019)

FINDINGS

Personal Information of the Surveyed Students

Among the surveyed THEIs' students, 70.0% were male while 30.0% were female (Table 1). The range of ages of surveyed students were between 21 and 39 and above years. 23.0% of the students had the age between 21–24 years, 39.0% between 25 – 29 years, 28.0% between 30 – 34 years, and 10.0% between 35 and above years (Table 1).

Since the unit of analysis of this study was two THEIs in Tanzania, the students were asked to identify the particular THEI they were pursuing in. In so doing, 52.0% of the students were at ATC while 48.0% were studying at DIT (Table 1).

The study intended to survey third year students of 2019/2020. The results display that, 63.0% of the students were pursuing engineering and 37.0% of the students were pursuing science and technology (Table 1).

Table 1: Personal information

| Information | Scale | Frequency | Percent |
|-------------------------------|-------------------------|------------|--------------|
| Sex | Male | 350 | 70.0 |
| | Female | 150 | 30.0 |
| | Total | 500 | 100.0 |
| Age | 21 – 24 years | 115 | 23.0 |
| | 25 – 29 years | 195 | 39.0 |
| | 30 – 34 years | 140 | 28.0 |
| | 35 – 39 years | 50 | 10.0 |
| | Total | 500 | 100.0 |
| Institution | ATC | 260 | 52.0 |
| | DIT | 240 | 48.0 |
| | Total | 500 | 100.0 |
| Specialization/Course Pursued | Engineering | 315 | 63.0 |
| | Science and Technology | 185 | 37.0 |
| | Others (e.g., Business) | 00 | 00.0 |
| | Total | 500 | 100.0 |

Level of Awareness of Students on DT in the THEIs

This section addresses the level of awareness of students on DT particularly

the level of digital skills as per the European Digital Competence Framework (DigComp; Eurostat 2019). The levels were obtained by asking students about digital activities performed within three months e.g., sending and receiving emails, participating in social networks, and seeking information online.

Regarding awareness of students in sending or receiving emails, the results in Table 2 portray that 39% of them had above-basic digital skills; 24% had basic digital skills; 20% had low digital skills; and 17% of the students had no digital skills.

Regarding awareness of students in participating in social networks, the results in Table 1 depict that 51% had above-basic digital skills; 36% had basic digital skills; 7% low digital skills; and 6% of the students had no digital skills (Table 2).

Regarding awareness of students in participating in seeking information online, the results in Table 2 illustrate that 45% had above-basic digital skills; 34% had basic digital skills; 7% low digital skills; and 6% of the students had no digital skills (Table 2).

Regarding awareness of students in installing software and applications, the results in Table 2 illustrate that 8% had above-basic digital skills; 12% had basic digital skills; 17% low digital skills; and 63% of the students had no digital skills (Table 2).

Regarding awareness of students in using online banking, word processing software and advanced spreadsheet functions; the results in Table 2 show that 7% had above-basic digital skills; 15% had basic digital skills; 21% low digital skills; and 57% of the students had no digital skills.

Generally, the majority of surveyed students in the two THEIs in Tanzania are found to have DT awareness above-basic skills in terms of sending or receiving emails, participating in social networks, and seeking information. On the other hand, the same students had no DT awareness in terms of installing software and applications; and using online banking, word processing software and advanced spreadsheet functions.

Table 2: Level of awareness of students on DT in the THEIs

| Scale | Sending or receiving emails | | Participating in social networks | | Seeking information online | | Installing software and applications | | Using online banking, word processing software and advanced spreadsheet functions | |
|----------------------------|-----------------------------|------------|----------------------------------|------------|----------------------------|------------|--------------------------------------|------------|-----------------------------------------------------------------------------------|------------|
| | # | % | # | % | # | % | # | % | # | % |
| Number and percentages | | | | | | | | | | |
| Above-basic digital skills | 195 | 39 | 255 | 51 | 225 | 45 | 40 | 08 | 33 | 07 |
| Basic digital skills | 118 | 24 | 178 | 36 | 170 | 34 | 58 | 12 | 73 | 15 |
| Low digital skills | 100 | 20 | 37 | 07 | 67 | 13 | 88 | 17 | 107 | 21 |
| No digital skills | 87 | 17 | 30 | 06 | 38 | 08 | 314 | 63 | 287 | 57 |
| Total | 500 | 100 | 500 | 100 | 500 | 100 | 500 | 100 | 500 | 100 |

Students’ Satisfaction on DT in Teaching-Learning Environment

The satisfaction of students on DT in teaching-learning environment in the surveyed THEIs particularly in online and distance learning courses had the following results: 82% of students were very

dissatisfied, 6% were somewhat dissatisfied, 8% were neither satisfied nor dissatisfied; 2% were somewhat satisfied, and 2% were very satisfied (Table 3).

Furthermore, 77% of students were very dissatisfied, 10% were somewhat dissatisfied, 8% were neither satisfied nor

dissatisfied; 3% were somewhat satisfied, and 2% were very satisfied regarding digital teaching and learning methods (Table 3).

Regarding open access to electronic resources and research results, the survey showed that 36% of students were very dissatisfied, 36% were somewhat dissatisfied, 18% were neither satisfied nor dissatisfied, 7% were somewhat satisfied, and 4% were very satisfied (Table 3).

The majority of the surveyed students were somewhat satisfied on DT in THEIs particularly on digital instructional planning with the following results: - 7% of students were very dissatisfied, 17% were somewhat dissatisfied, 4% were very satisfied; 60% were somewhat satisfied, and 12% were neither satisfied nor dissatisfied (Table 3).

The majority of the surveyed students were very dissatisfied on DT in THEIs particularly on digital instructional delivery shown by 62% of students were very dissatisfied, 23% were somewhat dissatisfied, 12% were neither satisfied nor dissatisfied; 3% were somewhat satisfied, and 2% were somewhat satisfied (Table 3).

In digital instructional assessment, 58% of students were very dissatisfied, 18% were somewhat dissatisfied, 10% were neither satisfied nor dissatisfied, 6% were

somewhat satisfied, and 8% were somewhat satisfied (Table 3).

The 11% of students were very dissatisfied, 19% were somewhat dissatisfied, 1% were neither satisfied nor dissatisfied, 47% were somewhat satisfied, and 22% were somewhat satisfied about digital communication with lecturers.

In general, the majority of surveyed students in the two THEIs in Tanzania were found very dissatisfied on DT in teaching-learning environment when considering online and distance learning courses; digital teaching/learning methods; open access to e-resources/research results; and digital instructional assessment. On the other hand, the same students were noted somewhat satisfied on DT in teaching/learning environment in terms of digital instructional planning and digital communication with lecturers. Conclusively, the students experienced dissatisfaction on DT in teaching-learning environment in the surveyed THEIs.

These results are contrary to what was previously found by other researchers. For instance, Santos & Marques (2019) previously noted that the students had variation about the ease, expectation, attitude and varied satisfaction in using DT technologies.

Table 3: Students' Satisfaction on DT in Teaching-learning Environment

| Scale | Online and distance learning courses | | Digital T/L methods | | Open access to e-resources and research results | | Digital instructional planning | | Digital instructional delivery | | Digital instructional assessment | | Digital communication with lecturers | |
|------------------------------------|--------------------------------------|------------|---------------------|------------|-------------------------------------------------|------------|--------------------------------|------------|--------------------------------|------------|----------------------------------|------------|--------------------------------------|------------|
| | # | % | # | % | # | % | # | % | # | % | # | % | # | % |
| Very dissatisfied | 412 | 82 | 387 | 77 | 181 | 36 | 31 | 07 | 311 | 62 | 292 | 58 | 57 | 11 |
| Somewhat dissatisfied | 32 | 06 | 48 | 10 | 178 | 36 | 93 | 17 | 108 | 23 | 89 | 18 | 97 | 19 |
| Neither satisfied nor dissatisfied | 39 | 08 | 37 | 08 | 91 | 18 | 20 | 04 | 60 | 12 | 49 | 10 | 06 | 01 |
| Somewhat satisfied | 10 | 02 | 17 | 03 | 31 | 07 | 299 | 60 | 13 | 03 | 32 | 06 | 233 | 47 |
| Very satisfied | 07 | 02 | 11 | 02 | 19 | 04 | 57 | 12 | 08 | 02 | 38 | 08 | 107 | 22 |
| Total | 500 | 100 | 500 | 100 | 500 | 100 | 500 | 100 | 500 | 100 | 500 | 500 | 500 | 500 |

Opportunity to Experience Digital Technologies in Teaching/Learning Process

In asking the students the opportunity they experience on digital technologies in teaching/learning process yielded the following results: 59% experienced low,

21% experienced moderate, and 20% experienced high opportunity on virtual and augmented reality in teaching/learning process (Table 4).

The majority of the students experienced low opportunity on artificial intelligence in teaching/learning process in the surveyed THEIs shown by 75% reporting low experience, 19% reporting moderate experience, and 6% reporting high opportunity experience (Table 4).

The majority of the students experienced low opportunity on Internet of Things in teaching/learning process in the surveyed

THEIs expressed by 50% of students reporting low opportunity experience, 41% reporting moderate opportunity experience, and 9% of the students reporting high opportunity experience (Table 4) of Internet of Things in teaching/learning process.

The above results generally indicate that, the students had low opportunity of experiencing digital technologies (i.e. virtual and augmented reality, artificial intelligence, and the Internet of Things) in teaching/learning process in the surveyed THEIs in Tanzania.

Table 4: Opportunity on digital technologies in teaching/learning process

| Scale | Virtual and Augmented Reality | | Artificial Intelligence | | The Internet of Things | |
|--------------|-------------------------------|------------|-------------------------|------------|------------------------|------------|
| | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| Low | 295 | 59 | 375 | 75 | 249 | 50 |
| Moderate | 105 | 21 | 97 | 19 | 203 | 41 |
| High | 100 | 20 | 28 | 06 | 48 | 09 |
| Total | 500 | 100 | 500 | 100 | 500 | 100 |

Students’ Difference/Comparisons on DT between ATC and DIT

This part presents the comparison between DT mean scores of those surveyed two groups of DIT and ATC students, i.e., are DIT students more digitally transformed than ATC Students? Is there a significant difference in the mean DT awareness scores between DIT students and ATC students? The reference here was one categorical independent variable (i.e., DIT/ATC Students); and one continuous dependent variable (i.e. DT awareness scores). The two variables used were students (with DIT coded as 1, and ATC coded as 2) and DTAW, which is the total score that students recorded on a five-item DT awareness scale.

Checking the information about the assessed groups, Table 5 provides correct mean and standard deviation for each of groups (DIT students and ATC students). The number of students in each group (N) is also right and no data is missing.

In meeting required assumptions of not violating equal variances of the t-test, the

results in Table 6 indicate that, the significance level for Levene’s test is 0.06 which is larger than the cut-off of 0.05. This implies that, the assumption of equal variances has not been violated hence the t-value reported used the one provided in the first line of the table.

In finding out whether there was a significant difference of DT awareness between DIT and ATC students, the column labelled Sig. (2-tailed) under t-test for equality of means was used. Table 6 then indicate that, the Sig. (2-tailed) value is 0.109. This implies that, there is no any statistically significant difference in the mean DT awareness scores for DIT students and ATC students.

Additionally, it was important to calculate the effect size for independent-samples t-test in order to provide an indication of the magnitude of the differences between DIT and ATC students in DT awareness.

The eta squared statistics was used in this study representing the proportion of variance in the dependent variable that is

explained by the independent (group of students) variable i.e.

$$\text{Eta squared} = \frac{t^2}{t^2 + (N1 + N2 - 2)}$$

$$= \frac{1.62^2}{1.62^2 + (240 + 260 - 2)}$$

$$= \frac{1.62}{2.6244 + 498}$$

$$= \frac{1.62}{500.62}$$

$$\text{Eta squared} = .003$$

With reference the guidelines by Cohen (1988) for interpreting this eta value (i.e., 0.01 = small effect, 0.06 = moderate effect, 0.14 = large effect); the effect size is very small i.e., 0.003 (0.3%). This implies that only 0.3% of the variance in DT awareness was explained by students. Summarily, an independent-samples t-test was conducted to compare the DT awareness scores for DIT students and ATC students. There was no significant difference in scores for DIT students (Mean (M) = 35.02, Standard Deviation

(SD) = 5.91) and ATC students [M = 34.17, SD = 5.11; t(408)=1.62, p= 0.11]. The magnitude of the differences in the means was very small (eta squared=0.003). With reference to all above results, it is concluded that there was no a statistically significant difference in the level of awareness on DT between DIT students and ATC students in Tanzania. The DIT and ATC were noted to have no difference in awareness of DT particularly in the teaching/learning environment.

Table 5: Group statistics

| DT | | N | Mean | Std. Deviation | Std. Error Mean |
|-----------------------------|-----|-----|-------|----------------|-----------------|
| Total DT Students Awareness | DIT | 240 | 35.02 | 5.91 | 0.37 |
| | ATC | 260 | 34.17 | 5.11 | 0.37 |

Table 6: Independent samples test

| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
|--------------------|-----------------------------|-----------------------------------------|------|------------------------------|---------|-----------------|-----------------|-----------------------|-------------------------------------------|-------|
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | | | | Lower | Upper |
| Total DT Awareness | Equal Variances Assumed | 3.508 | .064 | 1.624 | 408 | .109 | .85 | .52 | -.19 | 1.89 |
| | Equal Variances Not assumed | | | | 396.359 | .099 | .85 | .51 | -.17 | 1.87 |

CONCLUSION

The findings of this study conclude that, the majority of surveyed students in the two THEIs in Tanzania had DT awareness above-basic skills in terms of sending or receiving emails, participating in social networks, and seeking information but the same students had no DT awareness in

terms of installing software and applications; and using online banking, word processing software and advanced spreadsheet functions.

The surveyed students experienced dissatisfaction on DT in teaching-learning environment in the surveyed THEIs. Furthermore, the students had low

opportunity of experiencing digital technologies in teaching/learning process in the surveyed THEIs in Tanzania.

When comparing the two surveyed institutions, it is concluded that there was no a statistically significant difference in the level of awareness on DT between DIT students and ATC students in Tanzania. The DIT and ATC were noted to have no difference in awareness of DT particularly in the teaching/learning environment.

The findings of this study advocate the THEIs to fully adopt DT for maximally harnessing the opportunities of fourth industrial revolution through their product students. The institutions' students should be facilitated to fully practice digital technologies in the teaching-learning environment. The same study can be done in the future to all THEIs in Tanzania to expand this study and for drawing generalizability of all THEIs in Tanzania regarding implementation of DT.

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