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RESEARCH ARTICLE

Will Innovation, Training, and IT Support Moderate IT Investments in a Mandated Environment, Such as in a Covid-19 Era, to Create Value for Students in a Tertiary Educational Setting?

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Abstract

Objectives: To examine the creation of Value from IT investments for tertiary students. The focus was to use the complementary assets (Innovation, Training, and IT Support) as moderating variables for the relationship between IT investments and value creation in a mandated (Covid-19 setting) tertiary educational setting. **Methods:** One of the leading universities in Ghana was used as the object of study. A google form questionnaire was sent to the student body, and 508 responses were received. Smart PLS was used to analyze the responses. **Findings:** The results revealed that even though there was some level of interaction between the complementary assets (Innovation, training, IT Support) and IT investments, none of them had a significant effect on IT Value (Training > IT VALUE, p = 0.412; Innovation > IT VALUE, p = 0.371; IT Support > IT VALUE, p = 0.417). It was also revealed that IT investments was significantly correlated with IT Value (IT INVESTMENTS > IT VALUE, p = 0.000), confirming the insignificance of the moderators. In other words, the IT investments alone created value for the students. **Novelty:** The study is one of the early studies in IT value creation beyond IT investments in a mandated tertiary educational setting. In this study, it is evident that students in a mandated environment, such as in the case of Covid-19, where students are mandated to use the LMS and other IT infrastructure, will find their way out to create value for themselves once the IT infrastructure is in place; complementary assets may not be too necessary.

Keywords: Value; IT; Investments; Innovation; Support; Training

1 Introduction

Covid-19 has forced most organizations to go virtual or online. Learning Management Systems, Virtual Libraries, Virtual labs, and Online Portals, which represented huge IT investments and were less patronized because of other non-virtual alternatives, became very popular in a university setting. Students were, as a matter of urgency, required to use them to ensure non-breakage in the academic calendar due to the enforcement of social distancing, and so on. This work seeks to investigate whether there was a need for institutional capabilities to be put in place at the peak of Covid-19 to still create the needed value in the students from the vast IT investments to ensure a seamless transition from the traditional to a mandated environment or not. IT spending is a must-do in every facet of life [(1)]. All business functions revolve around IT infrastructure. It has come to a point where it does not matter so much as whether IT creates value; IT investments are inevitable to stay in business and be relevant in the industry or sector one operates in [(2)]. Regardless of the above statement, it is imperative to comprehend the dynamics of IT investments, both theoretically and practically, to aid in decision-making. Information Technology investments in institutions creating value research, known as the productivity paradox, has been dealt with extensively in literature from the late 1990s to the early 2000s. Literature on this subject for the past three to five years could be more extensive, as there seems to be some fatigue by researchers on the subject. Most of these studies have been conducted at the organizational and industry level, with scanty information regarding the educational sector. This work extends the argument to the educational sector by employing the middle ground in the paradox of looking at the role of complementary assets (Training, Innovation, and IT Support) in moderating IT investments to create value in students at the tertiary level, especially in a mandated environment. A mandated environment is critical to this study. It differentiates it from other studies, which generally deal with value creation beyond IT investments with or without complementary assets in a typical organizational setting and getting positive or negative outcomes.

Recent studies [(3–5)] reveal that IT investments might provide excellent results if organizational capabilities (complementary assets) are stressed favourably. These studies are, however, concentrated on the industry setting. Hardly will one find direct studies referencing the tertiary educational setting, even though substantial IT investments are made in the latter. This makes this study one of the few on IT investments and value creation in tertiary education. Concerning the educational sector, we discuss two most recent studies which looked at training in a Covid-19 era, even without referencing IT investments and value creation. Without any rigorous empirical data to support their claim, García-Morales et al. [(6)] recommended that special attention to digitalizing learning processes and offering specific technical training to professors, administrative staff, and students would help create value during mandated environments such as Covid-19.

On the other hand, Tamsah et al. [(7)], by using empirical data, found that training contributed significantly to training effectiveness (additional knowledge, ability to remember, ability to practice). In both studies, the importance of training has been emphasized to create value. This study employs training as one of the complementary assets used to moderate the relationship between IT investments and value creation in a tertiary education sector during the Covid-19 era.

Koi-Akrofi [(8)], working on the topic "Complementary assets and value creation beyond Information Technology Investments" in the telecommunications industry, came out with three complementary assets critical for value creation: Training of Staff on IT systems, staff being allowed to innovate with systems, and IT support to help

staff resolve issues as quickly as possible on the IT systems. This work uses these three aforementioned complementary assets as moderating variables for the relationship between IT investments and value creation in the tertiary educational setting.

Therefore, the main objective of this research is to contribute to the knowledge and research work in value creation beyond Information Technology (IT) investments, focusing on a tertiary educational setup. The specific objectives are, therefore:

1. To find the relationship between IT investments and value creation by employing training as a moderating variable in a mandated environment.
2. To find the relationship between IT investments and value creation by employing innovation as a moderating variable in a mandated environment.
3. To find the relationship between IT investments and value creation by employing IT Support as a moderating variable in a mandated environment.
4. To find the relationship between IT investments and value creation without any moderating variable in a mandated environment.

In addressing the research objectives, this study makes theoretical and practical contributions. First, this study gives empirical proof or otherwise to the assertion of complementary assets aiding value creation beyond IT investments, especially in the educational setting, with students using IT as the focus in a mandated environment. Second, this study proposes a guide to the management of universities as to the extent or level of investments in complementary assets alongside IT investments to ensure value creation. Third, this study contributes to the literature on value creation beyond IT investments and presents relevant research gaps to set future research agendas.

This study is organized as follows. The methodology employed is explained in the next section, and then the results and discussion. The study's conclusion, implication, and limitations are presented and discussed in the final section of this study.

2 Methodology

2.1 Research Design

This research adopts the quantitative research design approach. The quantitative approach is employed because it involves the systematic empirical investigation of social phenomena via statistical, mathematical, or computational techniques[9]. Combining the models of Maimbo and Pervan[10], Koi-Akrofi and Koi-Akrofi[11], and Koi-Akrofi[8], we come out with a working model for this research work. Figure 1 shows the model purposely tailored toward the tertiary educational setting. Maimbo and Pervan's[10] model looked at the performance (Share price, Net Interest Income, Non-Interest income, Operating Expense, Credit quality) of IT investments (transactional, strategic, and infrastructure) in the banking sector. Their model explained that performance is enhanced by five conversion effectiveness: Senior Management commitment to IS/IT, Experience of Organization with IS/IT, User Satisfaction with systems, Political Environment, and Organizational Structure. These conversion effectiveness items were also discussed in Koi-Akrofi and Koi-Akrofi[11]. This work looks at whether IT investments create value or not in a tertiary educational setting by moderating this relationship with the conversion effectiveness or complementary assets of Training, Support, and Innovation, as have been revealed in literature to aid IT investments to create value[8].

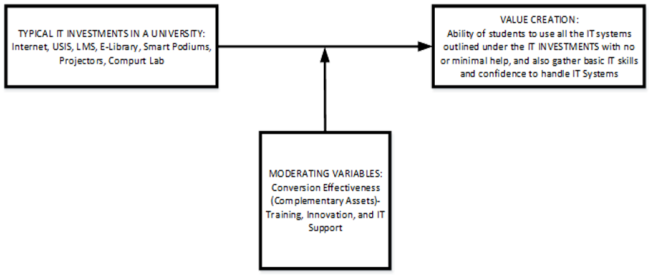

Fig 1. Value creation beyond IT investments model in the tertiary educational setting

Source: Adapted from the works of Maimbo and Pervan[10], Koi-Akrofi and Koi-Akrofi[11], and Koi-Akrofi[8]

2.2 IT Investments in the Tertiary Educational Setting

From Figure 1, the typical IT investments of the University in question are Internet Infrastructure, University Student Information System (USIS), Learning Management System (LMS), Virtual Library, Smart podiums, Projectors, Computer lab, and so on. The Internet Infrastructure is necessary for any work that requires the internet to go on smoothly—for example, sending and receiving emails, going onto internet-based platforms to work, virtual teaching and learning, and research work. No university can function without the internet. The internet must be accessible at every place on the campus (wireless routers) and must be fast as well. This requires considerable capacity investments in the bit rate (E1s or STM-1s) and internet equipment. The USIS, which also rides on the internet, is an information system software that requires much investment into its setup to get the required functionality for use by the students and lecturers. The students use the USIS to register for courses and check results. The lecturers use the USIS mainly for examination purposes, uploading results, and doing analysis. Both students and lecturers also use the LMS for virtual learning and assessment. It is also an information system software critical to the learning process in every educational setup. It is pretty challenging to set it up to suit one's setting and hence requires enormous investments in setting it up. The Virtual Library is a library on the internet. It is a repository of information for learning made up of referred journal databases and books, all subscribed by paying. Setting up this particular software and subscription presents a considerable investment. Smart podiums are entirely set up with teaching aids to help the lecturer deliver in a face-to-face class without any hitches or having to carry projectors, laptops, and HDMI cables around. This also presents a considerable investment. Projectors are fixed in every lecture hall for projection onto a screen for teaching. These are all expensive IT equipment procured by the University for learning. The computer lab has several IT equipment, software, and cables, all costly items necessary for practical training in IT.

2.3 Value Creation

Gains beyond IT investments can be tangible or intangible[8,12], financial, non-financial, market-oriented like market share in an industry, operational, strategic, organizational, and service[13]. Value in this case (the tertiary educational setting with students as the focus) deviates from the gains mentioned above. Value or gains resulting from IT investments in a tertiary institution has to do with the ability of students to handle IT systems on campus to do what they are supposed to do without lapses.

2.4 Hypotheses Formulation

Regardless of the many current research outputs pointing to the fact that complementary assets aid in creating Value for IT investments[3–5], we argue that in a mandated environment like in the case of this study, where Covid-19 was at its peak, and the fact that studies must go on regardless, we hypothesize as follows:

H1: Training does not significantly influence the effect of IT investments on value creation in a tertiary educational-mandated environment.

H2: Innovation does not significantly influence the effect of IT investments on value creation in a tertiary educational-mandated environment.

H3: IT Support does not significantly influence the effect of IT investments on value creation in a tertiary educational-mandated environment.

Tilting to the assumption that in a mandated environment such as at the peak of Covid-19, the new normal is the order of the day and that the students have to at all costs adjust to produce the needed results regardless, we hypothesize H4 as follows:

H4: IT investments have a significant effect on value creation when no moderating variable is employed.

2.5 The Survey Instrument

Google form questionnaire was used to collect the data. The University employed in the study is one of the leading public universities in Ghana, hereafter known as University U. Purposive sampling was employed because the respondents were restricted to only Information Technology Studies students at University U. The author chose this particular group of students from University U as a population. After all, he believes Information Technology Studies students are better placed in terms of understanding the subject matter of this research work and doing justice to the survey. Purposive sampling, or judgmental, selective, or subjective sampling, is a form of non-probability sampling in which researchers rely on their judgment when choosing population members to participate in their surveys. The questionnaire was based on closed-ended questions, dichotomous questions, as well as five-point Likert-type questions. Five constructs were used to design the questionnaire, with several items under each construct.

2.6 Population and Sample Size

The population consists of all Information Technology Studies students in the University U. This represents one department of the many departments of the University. The department runs two major programs, one at the degree level and the other at the diploma level. The diploma program has levels 100 and 200, and the degree program is 100 to 400. Therefore, the working population (all the registered students in the Department of Information Technology Studies of University U) was 1960 degree students plus 710 diploma students, making 2670 students. Employing a 4% margin of error, 95% confidence level, and 50% sample proportion, the expected sample size was calculated to be 491.

3 Results and Discussion

3.1 Introduction

A total of 508 responses were obtained. This number was slightly above the expected 491 sample size. Of the 508 students, 66.1% were degree students, and the remaining 33.9% were diploma students. Table 1 below shows the constructs, the items under each construct, and the source of the items from the literature.

Table 1. Constructs for the study

Construct	Name of items	Description
IT investments	ITIINT	Internet infrastructure
	ITISPP	Smart podiums
	ITIPPP	Projectors
	ITICLI	Computer laboratory
	ITIARC	USIS
	ITILMS	LMS
	ITIVLS	Virtual library
Training	TRAINT	I was given some form of training on how to use the internet when I was admitted into the University.
	TRAARC	I was given some form of training as to how to use the students' portal
	TRALMS	I was given some form of training as to how to use the LMS.
	TRAVLS	I was given some form of training as to how to access the virtual library system
Innovation	INNINT	I always have access to go onto the University's internet.
	INNLMS	I am able to navigate freely on the LMS without having to seek for administrative permission at the least thing
	INNCLI	I am given the chance to go to the computer lab and use it to learn IT on my own
	INNVLS	I am able to use the University's virtual library system in accessing learning materials without having to seek for administrative permission at the least thing
	INNARC	I am able to use the students' portal to do all that I am mandated to do on it without having to seek for administrative permission at the least thing
Support	SUPINT	There is a support team available for students to call for Support on how to use the internet or resolve students' issues with its usage
	SUPARC	There is a support team available for students to call for Support on how to use the students' portal or resolve students' issues with its usage
	SUPLMS	There is a support team available for students to call for Support on how to use the LMS or resolve students' issues with its usage
	SUPCLI	There is a support team at the computer lab to help students learn IT on their own

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Table 1 continued

	SUPVLS	There is a support team available for students to call for Support on how to use the virtual library system or resolve students' issues with its usage
IT value	IVCINT	I have access to internet any time and at any place on campus to learn, download relevant learning materials, and also do research with it
	IVCARC1	I am able to register all my courses online every semester without any problem or help from anyone.
	IVCARC2	I am able to check my examination results online any time and at any place without any problem or help from anyone
	IVCLMS	I am able to use the LMS to register for courses, learn effectively and do all my quizzes, assignments, and exams without any help.
	IVCVLS	I am able to access all library resources online and use them for learning and research.
	IVCCIS	After using the University's IT systems for some time now, my confidence with using IT systems has improved.

The PLS-Smart analytical tool was used to analyze data obtained from respondents. This is because it is considered an appropriate tool validated by the measurement and structural models[14].

3.2 Measurement model

The measurement model describes the measurement model's evaluation techniques for determining the measurements' reliability and validity. Hair et al.[14] presented three measurement models: indicator loadings, convergent validity, and discriminant validity.

3.3 Indicator Loadings

The recommended loading values should be > 0.708[15], and hence loadings below 0.708 should be dropped[16]. According to cross-loadings, a specific component should have larger loadings on its parent construct than on any other study construct. There are problems with discriminant validity if an item loads well onto another construct compared to its parent construct. The item may be cross-loading onto the other construct and pose a danger to discriminant validity if the difference in loading is less than 0.10. From Table 2, we see three items from innovation, one item from IT value, and one item from training (bolded and italicized), which fall below the 0.708 thresholds; nevertheless, the loadings on their parent constructs are still higher than the constructs, and so are maintained for the analysis. Generally, the items do not cross-load onto other constructs apart from their parent constructs. This means discriminant validity is achieved.

Table 2. Cross-loading

	Innovation	**IT investments**	**IT value**	**Moderating effect 1**	**Moderating effect 2**	**Moderating effect 3**	**Support**	**Training**
INNARC	**0.708**	0.194	0.502	0.159	0.089	-0.128	0.252	0.165
INNCLI	**0.676**	0.313	0.396	-0.007	0.025	-0.140	0.470	0.369
INNINT	**0.687**	0.320	0.484	0.006	0.024	-0.178	0.475	0.332
INNLMS	**0.604**	0.217	0.379	0.101	0.063	-0.141	0.207	0.160
INNVLS	**0.765**	0.261	0.479	0.073	0.009	-0.126	0.445	0.316
ITIARC	0.248	**0.791**	0.308	0.049	0.028	-0.182	0.146	0.092
ITICLI	0.210	**0.765**	0.217	0.011	-0.024	-0.131	0.134	0.111
ITIINT	0.342	**0.776**	0.342	0.027	-0.054	-0.159	0.313	0.284
ITILMS	0.360	**0.774**	0.333	-0.025	-0.037	-0.188	0.247	0.217
ITIPPP	0.238	**0.774**	0.257	0.002	-0.074	-0.150	0.180	0.130
ITISPP	0.272	**0.786**	0.308	-0.045	-0.017	-0.112	0.239	0.185
ITIVLS	0.324	**0.729**	0.258	0.003	-0.078	-0.176	0.298	0.327
IVCARC1	0.431	0.243	**0.712**	0.190	0.113	-0.165	0.232	0.056
IVCARC2	0.451	0.236	**0.732**	0.240	0.153	-0.195	0.297	0.092

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Table 2 continued

IVCCIS	0.492	0.316	**0.779**	0.126	0.098	-0.186	0.582	0.281
IVCINT	0.484	0.268	**0.635**	0.051	0.048	-0.164	0.516	0.353
IVCLMS	0.469	0.265	**0.769**	0.191	0.102	-0.188	0.305	0.130
IVCVLS	0.530	0.329	**0.754**	0.131	0.106	-0.214	0.497	0.301
SUPARC	0.447	0.232	0.516	0.095	0.044	-0.159	**0.906**	0.422
SUPCLI	0.516	0.278	0.500	0.061	0.051	-0.165	**0.836**	0.400
SUPINT	0.443	0.254	0.461	0.115	0.037	-0.154	**0.877**	0.380
SUPLMS	0.481	0.273	0.519	0.112	0.069	-0.173	**0.910**	0.480
SUPVLS	0.498	0.269	0.537	0.086	0.056	-0.181	**0.907**	0.430
TRAARC	0.301	0.149	0.217	0.074	0.058	-0.179	0.378	**0.803**
TRAINT	0.199	0.151	0.158	0.018	-0.034	-0.097	0.300	**0.635**
TRALMS	0.276	0.151	0.179	0.021	0.018	-0.039	0.305	**0.752**
TRAVLS	0.354	0.275	0.285	0.010	-0.072	-0.123	0.420	**0.798**

3.3.1 Convergent Validity (Internal Consistency Reliability)

The conclusion of the examination for statistical consistency across indicators is referred to as internal consistency reliability. Internal consistency reliability should be reported using Cronbach's alpha (α) and Composite Reliability (CR) [14]. Hair et al. [14] suggest a threshold of $\alpha > 0.700$ and CR of > 0.708.

Table 3. Convergent validity (internal consistency reliability)

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Innovation	0.723	0.731	0.819	0.476
IT Investments	0.887	0.893	0.911	0.594
IT Value	0.826	0.830	0.873	0.535
Moderating Effect 1	0.939	1.000	0.830	0.160
Moderating Effect 2	0.971	1.000	0.959	0.416
Moderating Effect 3	0.931	1.000	0.138	0.072
Support	0.933	0.934	0.949	0.788
Training	0.744	0.780	0.836	0.563

Table 3 shows that all variables' reliability was above 0.7, depicting a high level of reliability or dependability among the variables. Average Variance Extracted (AVE) values were also higher than 0.5 (except for three constructs that recorded low values; INNOVATION-0,476, Moderating Effects 1, 2, and 3-0.160, 0.416, and 0.072, respectively). The α and Composite Reliability (CR) values for all constructs have good internal consistencies, the reliability ranging from 0.723 to 0.939 for the α and 0.819 to 0.959 for the CR (except "Moderating Effect 3," which recorded low composite reliability of 0.138). As a result, there were no convergent severe validity issues [16].

3.3.2 Discriminant validity

The heterotrait–monotrait (HTMT) method [17] was employed to test discriminant validity for this study. The HTMT is a measure of similarity between latent variables. If the HTMT is smaller than one, discriminant validity can be regarded as established. The acceptable levels of discriminant validity should be (< 0.90), as suggested by Henseler et al. [17]. The results in Table 4 demonstrate that all values are less than one, indicating that all constructions are distinct.

Table 4. Discriminant validity using HTMT ratio

	Innovation	IT investments	IT value	Moderating effect 1	Moderating effect 2	Moderating effect 3	Support	Training
Innovation								
IT investments	0.465							
IT value	0.836	0.432						
Moderating effect 1	0.147	0.171	0.125					
Moderating effect 2	0.086	0.121	0.099	0.67				
Moderating effect 3	0.145	0.203	0.113	0.499	0.537			
Support	0.653	0.317	0.629	0.073	0.066	0.093		
Training	0.515	0.292	0.338	0.132	0.099	0.168	0.559	

3.4 Collinearity of Predictor Variables

Collinearity, in statistics, is a correlation between predictor variables (or independent variables) such that they express a linear relationship in a regression model. When predictor variables in the same regression model are correlated, they cannot independently predict the value of the dependent variable. The higher the value, the more significant the correlation of the variable with other variables. Collinearity problems may appear when the variance inflation factor (VIF) reaches or surpasses the value of five[17]. The Variance Inflation Factor (VIF) measures collinearity among predictor variables within a multiple regression. In our case, collinearity problems were observed between the constructs of IT investments and Support (see Table 5, bolded and italicized). Several irrelevant roles have been taken out of Table 5 (the interaction of individual items of support, training, and innovation with IT investments and items of IT value. Only composite figures are maintained). However, it must be quickly stated that in our case, we only have one independent variable (IT investments); the remaining variables (innovation, training, support) are moderating variables that interact with the independent variable and may affect the strength and direction of that relationship. The independent variable does not influence the moderating variables.

Table 5. Collinearity of predictor variables

INNARC	1.514
INNCLI	1.455
INNINT	1.37
INNLMS	1.371
INNVLS	1.593
SUPARC	5.189
SUPCLI	2.726
SUPINT	3.299
SUPLMS	4.63
SUPVLS	3.87
TRAARC	1.875
TRAINT	1.26
TRALMS	1.765
TRAVLS	1.349

3.5 Structural Model Assessment

Some phases were included in the structural model assessment [14]. We examined the path analysis and the various relationships (including hypotheses testing) between constructs of the model employed in the study. These include the structural model relationship, the coefficient of determination (R2), the fitting model parameters, and the moderating effect graphs.

3.5.1 Structural Model Relationship

Figure 2 illustrates the path analysis for the study. Path analysis can be examined from various perspectives depending on the study's objectives. We were interested in examining the relationship between IT investments and value and the moderating effects of Training, IT Support, and Innovation. Node-to-node path analysis aligned with the objective of the study, as well as the hypotheses developed. These are illustrated in Table 6 .

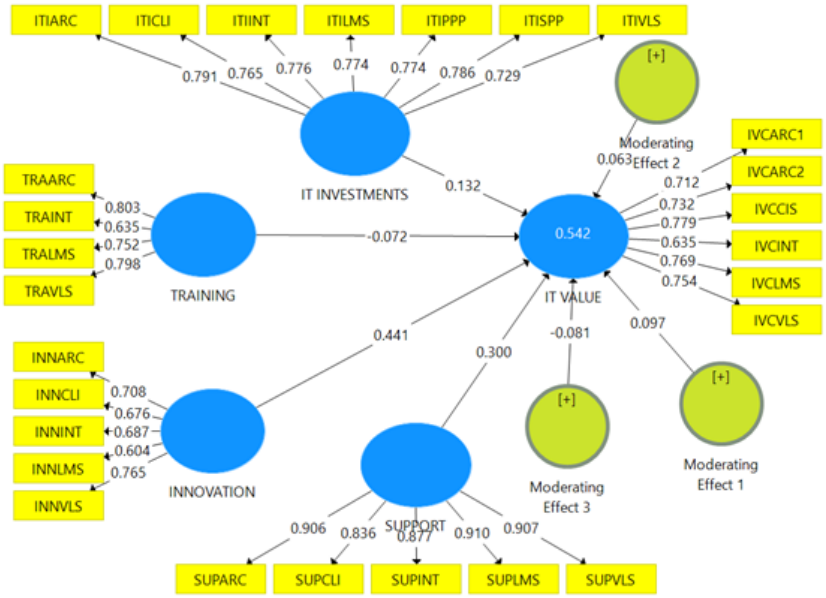

Fig 2. Path analysis

Table 6. Node to node path analysis

	Original sample (O)	T statistics (|O/STDEV|)	P-values
INNOVATION -> IT VALUE	0.441	10.403	0.000
IT INVESTMENTS -> IT VALUE	0.132	3.597	0.000
Moderating effect 1 -> IT VALUE	0.097	0.896	**0.371**
Moderating effect 2 -> IT VALUE	0.063	0.812	**0.417**
Moderating effect 3 -> IT VALUE	-0.081	0.822	**0.412**
SUPPORT -> IT VALUE	0.300	6.751	0.000
TRAINING -> IT VALUE	-0.072	1.989	0.047

3.5.2 Hypothesis Testing

Table 7 shows a summary of the output of the moderating hypotheses. The output reveals that none of the moderating variables, namely, TRAINING, INNOVATION, and IT SUPPORT, were significant, and hence the hypotheses H1, H2, and H3, respectively, were supported. Again, in Table 7 , we realize that H4 was supported. That means that IT investments result in IT value; in other words, IT Value from IT investments in a mandated environment does not need any moderating variable in the confines of the variables defined in this study. Going by operational interpretation, it simply means that in a mandated

tertiary educational setting, it is enough to invest in IT for the students, and the students will do everything possible to create value from the investments by themselves; they do not need so much of a support, training, and innovation to create value.

Moving away from the hypotheses analyses and referring to the moderating graphs (see Figures 3, 4 and 5), we can still concentrate on the nature of the graphs and make some analyses. From Figure 3, the results revealed that IT investments was found to have a more substantial impact on IT Value at higher levels of innovation. There is some interaction outside the observed values representing an ordinal interaction. Extrapolating the graphs to the interaction point, the interaction point is likely to fall in the negative zone of IT investments and IT Value, with the -1 SD line staying on top. This means that at lower levels of Innovation, IT investments was found to have a negative impact on IT Value. The same can be said for IT Support. For training, the situation is different. The interaction is not ordinal; that is, the interaction happened within the observed values. That explains the -0.081 value for the coefficient, suggesting a negative relationship between IT investments with IT value. In reality, IT investments positively impact IT Value at higher levels of IT training. However, the overriding decision lies with the behaviour of the graph after the interaction point within the observed values. The -1 SD line stays on top after the interaction point within the observed values. Hence, the interpretation goes this way: generally, IT investments negatively impact IT Value for training as a moderating variable.

Table 7. Hypotheses testing

Hypothesis	Hypothesis Statement	Path	Original Sample (O)	T Stats	P Value	Status
H1	Training does not significantly influence the effect of IT investments on value creation in a tertiary educational mandated environment	Moderating Effect 3 -> IT VALUE	-0.081	0.822	0.412	Negative influence and hypothesis Supported
H2	Innovation does not significantly influence the effect of IT investments on value creation in a tertiary educational-mandated environment.	Moderating Effect 1 -> IT VALUE	0.097	0.896	0.371	Positive influence and hypothesis Supported
H3	IT Support does not significantly influence the effect of IT investments on value creation in a tertiary educational mandated environment.	Moderating Effect 2 -> IT VALUE	0.063	0.812	0.417	Positive influence and hypothesis Supported
H4	IT investments have a significant effect on value creation when no moderating variable is employed.	IT INVESTMENTS -> IT VALUE	0.132	3.597	0.000	Hypothesis Supported

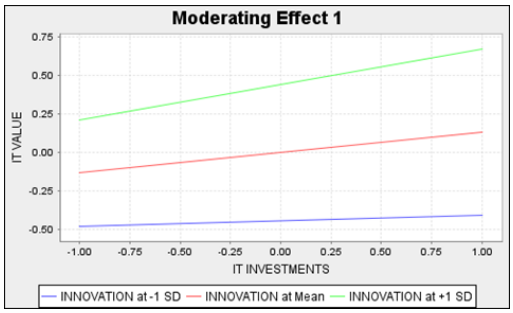

Fig 3. Innovation effect on IT investments

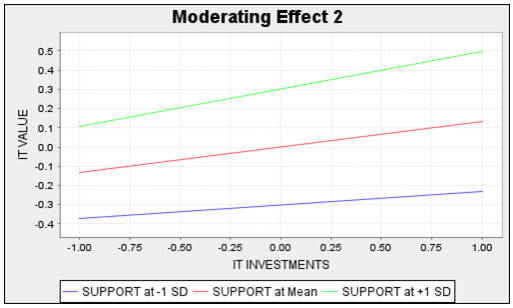

Fig 4. IT Support effect on IT investments

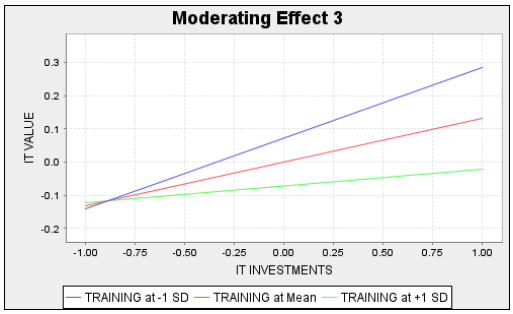

Fig 5. Training effect on IT investments

3.5.3 Coefficient of Determination (R^2)

The variance percentage in endogenous variables that the exogenous variable may predict is interpreted as the coefficient of determination (R^2), which is the regression analysis's output value. It assesses a suggested model's prediction accuracy. It is calculated as the square of the correlation between two endogenous constructs. The R^2 scale runs from 0 to 1; a more significant number indicates a higher level of R^2; 0.75 indicates a significant level of R^2; 0.50 indicates a moderate level, and 0.25 indicates a poor level of R2 [14]. From Table 8 , the results are as follows: IT value (0.542). In summary, the results of R2 show a moderate level of R^2.

Table 8. Coefficient of determination

	R Square
IT VALUE	0.542

3.5.4 Model Fitting Results

The model fitting results is summarized in Table 9. While CB-SEM strongly relies on the concept of model fit, this is much less the case with PLS-SEM [14]. Consequently, some researchers incorrectly conclude that PLS-SEM is not helpful for theory testing and confirmation [18]. Some methodologists have endorsed model fit measures for PLS-SEM [19], but researchers should be cautious when considering these measures' applicability for PLS-SEM [14,20]. Based on this, the authors decided not to analyze the model-fitting results. The results are, however, shown Table 9 for reference.

Table 9. Model fitting

	Saturated Model	Estimated Model
SRMR	0.093	0.093
d_ULS	3.277	3.269
d_G	0.665	0.665
Chi-Square	2192.944	2190.038
NFI	0.727	0.728

3.6 Implications of the Study

Theoretically, this work contributes to the literature on IT investments and value creation in an educational setting. The results reveal that IT investments in a mandated tertiary educational setting may not need additional investments in complementary assets to create value for the student body. Practically or operationally, this research can guide or inform managers of universities to be circumspect in investing in complementary assets to enhance student's ability to create value from the numerous IT investments on campus or elsewhere.

4 Conclusion

This study addresses the need for empirical investigations on the productivity paradox in tertiary educational settings in developing countries. Specifically, this study assessed whether the complementary assets innovation, training, and IT support serving as moderators would impact IT investments in creating value in the students in a mandated environment. The study's findings revealed that none of the moderating variables was significant (Training > IT VALUE, p = 0.412; Innovation > IT VALUE, p = 0.371; IT Support > IT VALUE, p = 0.417), and this supported the hypotheses H1, H2, and H3. This result is in line with the findings of Teece[21], who also did not realize IT value from complementary assets but indicated that they might be needed for the technology to function. It was also revealed that IT investments significantly correlated with IT Value (IT INVESTMENTS > IT VALUE, p = 0.000), confirming the moderators' insignificance and supporting hypothesis H4.

The results are also consistent with recent works of researchers[3–5,11,22,23] who also concluded in their research work that IT investments result in performance or IT Value without necessarily investing in complementary assets such as training, IT Support and Innovation. However, most of these research works were done at the firm and industry levels. Meta-analysis is also sometimes used. Studies of this nature in a tertiary educational setting are rare. Hence the significant nature of this research contributes to the body of knowledge in this area. While Koi-Akrofi[24] recently revealed the significance of training, Innovation, and IT Support in helping produce IT value in organizations, this work proved otherwise in a mandated tertiary educational setting. A typical case of a complementary asset moderating the link between IT investments and IT value in an organization is the research of Mithas and Rust[25] in their work "How information technology strategy and investments influence firm performance: conjecture and empirical evidence" where it was revealed that IT strategy plays a significant role in moderating the relationship between IT investments and firm performance. Also, not only does digital innovation provide financial benefits by enabling new revenue streams. It is advised for businesses to actively consider and plan for the various forms of value that digital innovation can provide[26]. Clearly, for firm analysis, the results will likely tilt to complementary assets aiding IT investments to create value. This may not be the case in a tertiary-mandated educational setting, as evidenced in this research. In this study, it is evident that students in a mandated environment, such as in the case of Covid-19, where students are mandated to use the LMS and other IT infrastructure, will find their way out to create value for themselves once the IT infrastructure is in place.

5 Study Limitations and Future Research Directions

This study is limited to the following areas. First, we only focused on students in the tertiary institutional space. Future studies can focus on learning facilitators and administrative staff who use IT infrastructure in the University. Second, future studies can adopt a mixed-method approach to solicit the views of IT users in mandatory environments to understand the value IT creates for them with or without investment in complementary assets such as training and IT Support. Again, future studies can expand the list of complementary assets based on literature and test them to see how they will behave and moderators concerning IT investments and IT Value.

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