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Exploring Technology User Environments in Higher Educational Institutions: A Bioecological Theory Based Framework

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Abstract The paper provides a renewed framework for framing technology user environments among higher educational institutions. We propose the need to explore and understand the appropriate technology user environment as a prerequisite to deploying technologies in institutions of higher learning. The proposed framework developed from the perspective of the bioecological theory. The use of technologies for teaching and learning naturally takes place in a bio-ecological environment. It is now acceptable that the academic environments in which technologies are deployed and used have primary features associated with the bioecological theory. Some writers and researchers have therefore related the deployment of technologies in tertiary institutions to the bio-ecological theory. Some of these studies lack emphases on users of technology in an academic environment. Moreover, some individual conceptual studies have failed to recognize some important arms of the natural framework. We also consider the body of evidence on the subject subtle. We, therefore, want to uphold the need to know and understand the appropriate technology user environment as a prerequisite to deploying technologies in higher institutions by revealing a renewed framework for framing it. In this paper, we use conceptual and theoretical studies that employ the bio-ecological theory in forming frameworks relating to technology user environments. The studies used are largely from peer-reviewed journals, but we also used to work and white papers written on the subject. The typical technology user environment has essential features of the bioecological theory. A resounding attribute of this environment is the links or harmony between its subjects (users) and how these relationships extend to choices of technologies, user characteristics and the specific uses of technologies for students, faculty members and institutional management. Management of higher academic institutions can frame their technology user environments by considering the dimensions of the bio-ecological theory (i.e. microsystem factors, mesosystem factors, exosystem factors, and macrosystem factors) along the lines of choices of technologies, user characteristics (such as skills and ability to use technologies) and the specific uses of technologies for students, faculty members and institutional management.

Keywords: *higher education, technology user environment, ecosystem theory*

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1. Introduction/Background

The world is witnessing swift upgrades and advancements in the use of technologies. Moreover, the use of technologies is increasingly permeating every aspect of organisational and business management. For instance, we are currently seeing the large role of technologies in teaching, learning and management of higher educational institutions [4,15]. Similarly, the use of technologies has enhanced teaching and learning by enabling an efficient system of communication among students, faculties and university managements [4,6]. Logically, students, teachers, university managements and potential students of the public are the subjects of a composite academic environment. These subjects naturally need to be integrated into the process of using technologies for individual and institutional purposes.

In simple terms, Lewthwaite ([12], p. 6) identifies an academic environment as a community of two or more classes of people interacting in a common way. There is a commonality in what subjects do in a university environment because every activity is "academic" [10,12]. On the contrary, there is some level of heterogeneity in what these subjects do since what a student uses technology for is not the same as what a university administrator uses it to achieve [12]. It means that the choice of technologies made by students would not be the same as that of a university administrator. Like all bio-ecological environments, there is so much diversity in an academic environment in which students, faculties,

university managements and potential students of the public engage in interactions. That is why Jones & Jo [10], Lewthwaite [12] and many other writers have imported the essence of the bioecological theory in describing and framing technology user environments.

Researchers often argue that the productivity of technologies to a higher academic institution depends on how well its management make choices of technologies based on an understanding of its academic environment [10,12]. In line with this argument, educational institutions ought to understand the components of their environments and the interaction among these components. By understanding their environments, academic institutions would be able to make the best choices of technologies and can tailor their functions towards maximum efficiency and their general performance [12,17]. Well recognized educationists (e.g. [10,12,17]) have expressed the view that an understanding of academic environments in this respect is comparatively better when achieved from the perspective of the bioecological theory.

The bioecological theory, attributed to Bronfenbrenner [3], argues based on the biological changes and growth in subjects of an environment and the network of interactions within which these changes and growth occurs. Later, after proposing this theory, Urie Bronfenbrenner and other proponents of his theory (e.g. [7,10,11,12,13]) wrote on the applications of these theories to business networks and organisational behaviour. Also, Jones & Jo [10] and Lewthwaite [12] are the few writers who tried to adapt the theory to human behaviour and development in an academic environment. Adomavicius et al. [1] and HR.com [9] provided an overview of the theory from the perspective of technology deployment.

Though some conceptual studies (e.g. [7,10,11,12,13]) have indicated how the bio-ecological theory could be used to understand human development and behavior in an organization, very few studies have indicated the relevance of the theory to framing technology user environments among tertiary institutions. Thus, the need to understand academic environments regarding their components, human subjects and technological needs in efforts to deploy technologies seems to be undermined by university managements.

In this paper, we relate the bio-ecological theory to the environment of academic institutions and identify factors that are worth considering before the deployment of technologies in educational environments. The paper seeks to provide a conceptual approach to framing technology user environments among academic institutions of higher learning. These are detailed in this paper under the following subsections.

1.1. Related Work

Academic environments have human factors, for that matter biological attributes. Anything human or biological has sufficient bearing on the bioecological theory. Based on the argument of Bronfenbrenner [3] through the bioecological theory, an academic environment is a natural setting of humans (i.e. students, faculties, university managements and potential students of the public) whose behaviors and development relate to the diversity of interactions in this environment. From the standpoint of this theory, technology is a non-human component that influences interactions among the human components (i.e. students and other subjects) in the academic environment [1,9]. It means that the deployment of technologies in an educational environment can trigger a course of action that was absent in the academic environment before technologies were incorporated.

Since the deployment of technologies comes to add diversity to the original interaction among subjects, the success of deploying technologies in academic environments depends on how suited the environment is to the choice of technologies, the characteristics of the subjects and how well the interaction between subjects is managed [1,9,10,12]. This idea regarding the suitability of the technologies to the academic environment and the efficient management of interactions among subjects is rooted in the bio-ecological theory [1,12]. This implies that higher institutions of learning would need to deploy technologies in an environment where three situations are inherent: (1) technologies are chosen to meet the needs and skills of students, faculty members, university managements and council, and potential students of the general public; (2) there is agreement among these subjects in using technologies; and (3) the deployment of technologies correlates with other activities (i.e. tutoring, learning, application for admission, etc.). These three situations define the nature of academic environments in which technologies are successfully deployed [1,9,10,12].

1.2. Comparison with Other Approaches

Social Construction of Technology (SCOT) supports the argument that Information Communication Technology (ICT) does not determine human action; however, human action rather shapes ICT [2]. Advocates of the SCOT are of the belief that the use of technology cannot be understood without initially perceiving the social context of the ICT. To this, the premise of using the bioecological framework is related to human-influenced technological interrelationships occurring in an ecosystem environment. The interpretivist affordances of the bioecological framework relate to the acknowledgement that human actions silhouette the course of ICT's adoption and utilization. Concerning the transpiration in the ecosystem, the native inhabitants (students, teachers, and stakeholders) are the orchestrators and determinants of which ICT to use, how to use it and where to apply it.

Actor-Network Theory (ANT) is another theoretical means of thoroughly exploring the relationships within a network (an assortment of things). ANT, which is mostly constructivist, is devoid of essentialist positioning.

Wu [16] situated the Technology Acceptance Model (TAM) within the positivist paradigm. Wu [16] attributes this to consideration that TAM studies assume that system features and user characteristics are static, which led to their conceptualization as fixed, transferrable, and quantifiable. The positivist affordances of the TAM are catered for in the bioecological framework because of its applicability to positivist studies.

The use of our bioecological framework takes a realist position, which affords considerations from positivist and interpretivist perspectives or both.

2. Methodology

To achieve the principal objective of this study for which a conceptual framework is developed, there was the need to characterize subjects within a technology user environment.

2.1. Characterizing Subjects within a Technology User Environment

The most fundamental conception towards the deployment of technologies in higher institutions of learning is about people who would use these technologies. We would want to refer to these people as "subjects" within a technology user environment. Management of an academic institution ought to acknowledge users or subjects before acquiring technologies because the bio-ecological theory implies that the adoption of technologies could influence the course of action of users [1,12]. Therefore, a consideration of subjects will enable management to acquire and adopt technologies that could influence the subjects and their interests positively. As a reminder, one of the situations required in the deployment of technologies is the agreement among subjects, their skills and activities and the technologies they use. Logically, a consideration of subjects is a priori to a proper selection of technologies and the framing of the needed academic environment and user skills.

Now, who are the specific users of technologies in an academic environment? Zare-ee (2011) identifies them to be students, faculty members, university managements (including council), potential students of the public (those applying for admissions or those the institution is targeting for admission [6]). Practically, this category of users could use technologies of the institution for filing admissions online, or the university may use these technologies to communicate with them. By identifying these four categories of users, management can successfully visualize users' needs and skills and can acquire suitable technologies for them. A consideration of these categories of users is highly important because they have unique technology needs and skills. Another key feature that academic managements must know and understand is the position of each subject in the technology user environment.

We discuss this under findings in the next section.

3. Findings

The resulting bio-ecological conceptual framework for understanding technology user environments in HEIs has been depicted in Figure 1. Findings connoted from this framework have subsequently been iterated in the subsequent sections.

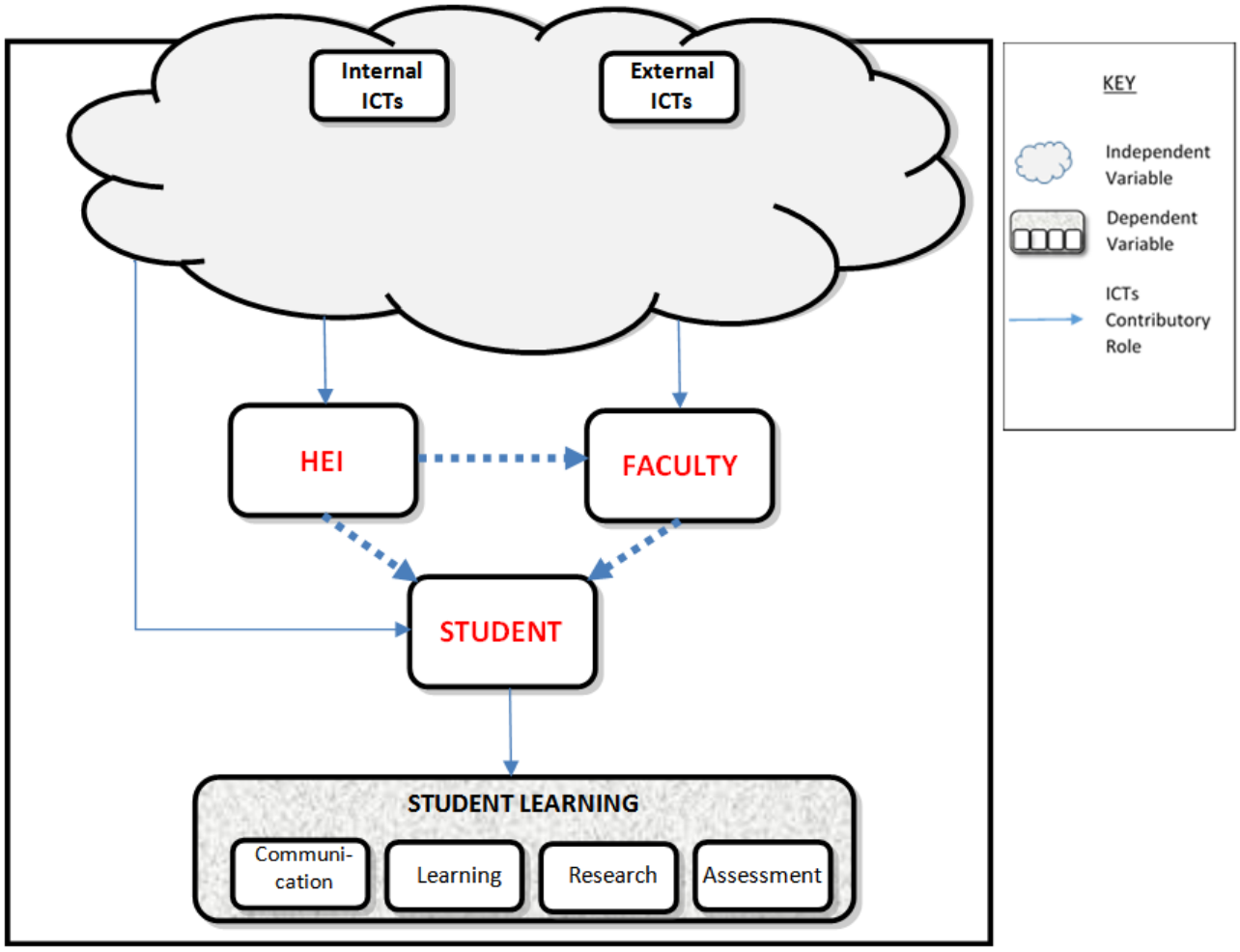

Figure 1. A Conceptualization of the Technology User Environment

3.1. The Positions of Subjects in the Technology User Environment

We present in Figure 1 a conceptualization of the technology user environment, which largely embraces primary characteristics in a proverbial bioecological environment. The framework reflects the core features of a bioecological environment, as projected in the bio-ecological theory because each of its units interacts with another unit in a fashion of diversity. For instance, the external and internal ICTs are all linked to the higher educational institution (HEI), students and faculties. We assume that the faculty unit includes management and university council, where students involve potential students. In the context of deploying technologies in higher institutions of learning, we could refer to this framework as the biotechnological environment. This framework is a build-on version to the one developed by Lewthwaite [12] which is not linked to the practical application of the technologies in a higher academic environment.

In Figure 1, each subject is given its natural position. First, we need to understand that the environment is a definition of the relationship between the institution, its faculty and students. The institution (HEI) represents the housing unit for students and faculties. This means that faculties and students are subject to the institution, or they form part of the institution. Naturally, students are subject to faculties, and this is what is visualized in the figure. Student learning is at the extreme end of the chain; but this does not mean that technologies are only used by students in the academic environment; it only throws light on the technology needs of students who are naturally the customers being served. In this framework, we give priority to the technology needs and uses of students because all academic institutions aim at boosting positive impact on students. In making our findings evident, we would want to relate this framework to practice and the bio-ecological theory in the next section.

4. Discussion

4.1. Framing Technology User Environment

Based on practical experiences and evidence from other conceptual studies (e.g. [1,9,10,12]), we propose that framing technology user environments from the perspective of higher academic institutions should be done in two ways: (1) considering the dimensions of the bio-ecological theory; and (2) relating its basic implications to practicing the relationships shown in our framework (see Figure 1). Concerning the first dimension, there is the need for academic institutions to initiate the use of technologies at the individual, microsystem, mesosystem, exosystem and macrosystem factor levels [12]. At the individual factor level, managements will need to help individual subjects to relish the deployment of technologies by equipping them with appropriate skills and attitudes. This will enable them to savor technologies in the relationship expressed in Figure 1. At the microsystem level, members in the same category of subjects or users will need to support each other in the use of technologies. For instance, students will have to help fellow students, and faculty members will have to support each other. At the mesosystem factor level, we expect support to be extended to institutional managements, possibly in the acquisition of technologies and in understanding the relevance of technologies to achieving desired change [1,12]. At the exosystem factor level, academic institutions will need technical and financial support from subjects not directly found in the technology user environment at the tertiary level. This support is required towards the acquisition, installation, use and periodic repair of technologies. At the macrosystem factor level, academic institutions will need to deploy technologies in harmony with any existing state policy for leveraging technologies in teaching and learning. In this respect, the entire state influences the dimension of activities resulting from the deployment of technologies.

A second aspect in framing technology user environments among tertiary institutions is ensuring that the links among students, faculty, management and potential students (as shown in Figure 1) exist along the lines of choices of technologies users, their characteristics (such as skills and ability to use technology) and the specific uses of technologies for each category of subjects. Moreover, managements should pay attention to the technological needs and skills of each category of subjects or users to be able to frame the technology user environment. It is believed that this consideration will enable managements to choose suitable technologies that match institutional needs (i.e. the needs of all subjects) and user abilities. To complete the task of framing the technology user environment, sustainability of courses of action must be pursued at the levels of: (1) considering the dimensions of the bioecological theory, as discussed earlier; and (2) relating its fundamental implications to practicing the relationships shown in Figure 1. This is since a bioecological environment is degradable when its desirable features degenerate [3,12].

4.2. Relevance of Using Bioecological Theory Based Framework

The bioecological framework is relevant in providing a theoretical lens in perceiving the use of technology in not only higher educational institutions but other organizations as well. Adapting this framework is ideal for research with the motive of observing the contexts in which people interact with technologies within an environment. It further becomes useful in detailing how a new technology causes change and is subjected to change in a community setting. The framework further provides modifiable characteristics of individual inhabitants in an ecosystem that have a rippling effect of the introduced technology. This aspect makes it comparatively easier in perceiving effects of an introduced technology on individual's characteristics in an institutional ecosystem.

The use of the bio-ecological framework, as explained above, is justified from two perspectives in previous studies. The first perspective supports the deployment of technologies in an organisation, regardless of which specific types of technologies are involved (e.g. [10,12,17]). The second viewpoint supports the deployment of technologies in academic institutions

which are expected to use specific technologies suited to their activities (e.g. [1,12]). In any of these viewpoints, the bio-ecological theory is used as a basis for explaining and understanding the relationship among subjects of academic environments and the interaction between the subjects and technology itself. Adomavicius et al. [1] however suggest that researchers need to pay attention to the second perspective if the interest is to determine and frame an academic environment for the deployment of technologies. This suggestion is worth heeding, but not much has been done in its direction. This framework caters for developing educational environments suited to the deployment of technologies.

The systemic conceptualization of Urie Bronfenbrenner's ecosystem as represented in the bioecological framework makes it possible to categorize interrelationships within three core dimensions; the microsystem, the mesosystem, and the chronosystem. More so, using this epistemological standpoint is comparatively more accommodative to positivist and interpretivist perspectives.

5. Conclusion

We in this paper seek to propose a priori consideration of technology user environments towards the deployment of technologies in higher institutions of learning. This proposed framework deals with an extension of an examination of the relationships among students, faculty members, managements and potential students and their abilities to use technologies to a consideration of the specific technological needs of each category of subjects in the academic environment. We also think that such considerations should be made along the dimensions of the bio-ecological theory, so the deployment of technologies will be sustainable and more efficient. The idea behind our framework is that a technology user environment (from an academic perspective) must be well developed to facilitate productive use of technologies. The development of this environment would be futile and ineffective without its understanding along the dimensions of the bio-ecological theory and the framework of Figure 1.

We take out certainty of the relevance of our framework to the deployment of technologies in higher institutions from the previous conceptual studies of Jones & Jo [10], Adomavicius et al. [1], Lewthwaite, [12], and HR.com [9], and the fact that features of the bio-ecological theory imported into the framework of Figure 1 have been confirmed in empirical studies. Lewthwaite [12] argues that this framework is practical and realistic; requiring that empirical researchers take up the task of investigating the relationships and other proposed features of the technology user environment. Coupled with our experience and understanding of how technologies work in academic environments, we make the following conclusion:

Management of higher academic institutions can frame their technology user environments by considering the dimensions of the bio-ecological theory (i.e. microsystem factors, mesosystem factors, exosystem factors, and macrosystem factors) and relating its basic implications to practicing the relationships shown in Figure 1. Also, the links shown among subjects in the framework must be considered along with the lines of choices of technologies for each category of subjects, their characteristics (such as skills and ability) and the specific uses of technologies for each category.

There is, however, the need for more conceptual studies on the subject. Moreover, it is high time empirical studies are conducted to verify the practicality of this framework and related ones such as those developed by Adomavicius et al. [1] and Lewthwaite [12].

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