Intrinsic motivation as a determinant of perceived usefulness of library makerspace: the influence of learning dimensions

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ABSTRACT

An increasing number of academic libraries are providing techno-savvy spaces, generally regarded as makerspace, that plays a significant role to serve the learning needs of university students. Yet, the underutilization of these makerspaces among learners in Nigerian universities is a growing concern. This study suggests a model using the Self-Determination Theory and the Tinkering Learning Dimensions Framework to investigate the influence of intrinsic motivation and learning dimensions (learning engagement and social scaffolding) on the perceived usefulness of library makerspace among Nigerian university students. Using a quantitative approach, four hypotheses were developed to examine the relationship between the constructs. Data from 323 valid respondents were analyzed using structural equation modeling. The findings reveal that intrinsic motivational factors have no direct statistically significant influence on the perceived usefulness of library makerspace. However, the relationship is mediated by an indirect influence of learning engagement. Social scaffolding and learning engagement were both found to have a direct significant influence on the perceived usefulness of makerspace. This study contributes to understanding the factors that influence the perceived usefulness of makerspace which would then lead to the increased use of this collaborative workspace. Contribution to the literature of the utilization of makerspace is discussed based on the presented framework.

Keywords: Academic libraries; Library makerspace; Intrinsic motivation; Perceived usefulness; Social scaffolding; Nigeria.

INTRODUCTION

Researchers have considered makerspace as an exodus from traditional learning, that enables learners to engage with the real world in playful and useful ways to boost innovation and provide solutions to problems (Cantelon 2018; Martin 2015). This development is characterized by the presence of classical technological equipment such as 3-D printers, laser cutters, prototyping equipment, and basic handiwork tools (Blikstein

2013). Generally, the makerspace is defined as a formal or informal location for innovative making in science, engineering, and art, where people of all ages use physical and digital tools to learn technical skills and to discover ideas based on their interests through collaborative activities (Sheridan et al. 2014). This influences the grassroots of do-it-yourself (DIY) citizenship which promotes the ability to create rather than consume. The primary goal is to allow an individual to have access to space, tools, and software to foster creativity, and innovation to solve a problem. This will then motivate users to perceive it as a useful space for learning and self-development. Colegrove (2017) believes that the core library values, such as equitable access to information, resources, and opportunity for lifelong learning, makes the library a natural provider of makerspace. In their efforts to develop a library makerspace assessment plan, Welch and Wyatt-Baxter (2018) report that despite the availability of hands-on instruments provided for students to innovate and create, the evolution of makerspaces in academic libraries was still in its early stages, though indicating a significant educational development.

Despite numerous challenges affecting makerspace, in addition to poor funding and low level of awareness of the concept of makerspace, studies indicate that non-attractiveness and low user patronage are the major issues affecting the establishment of makerspaces in Nigerian libraries (Okuonghae 2019; Osawaru, Dime and Okonjo 2020; Rhima 2021). This could be attributed to the students' attitude toward innovation and how they perceive the library makerspace to be useful to them. Keshinro and Oyewole (2021) found that secondary school students in Nigeria had a positive attitude towards innovation and their perceived usefulness of library makerspace influenced their actual use of the collaborative workspace. Hence, perceived usefulness is a significant determinant which could help learners accept library makerspace and increase its usage. Several researchers have recommended that to retain habitual users and attract new users to the makerspace, motivational factors should be considered (Casakin and Kreitler 2010; Corsini and Moultrie 2020). Motivation has the power to bring people together to exchange ideas and improve their skills. As makerspaces offer informal physical spaces, in a community setting of an academic institution, users are motivated to immerse themselves in creative making (Becker et al. 2016) and this facilitates users' learning.

In an attempt to further developing an understanding of influencers to makerspace use, this study suggests a model to investigate what influences students' perceived usefulness of makerspace in Nigerian academic libraries. Focussing on the role of intrinsic motivation (autonomy, relatedness, competence) and the users' learning dimensions, the following research questions guides this investigation:

(a) What effect does intrinsic motivation have on the perceived usefulness of library makerspace in Nigerian academic libraries?
(b) What effect does social scaffolding and learning engagement have on the perceived usefulness of library makerspace in Nigerian academic libraries?
(c) Does learning engagement have a mediating effect between intrinsic motivation and perceived usefulness of library makerspace in Nigerian academic libraries?

LITERATURE REVIEW

The concept of makerspace in libraries is a nascent technology that has come to restore parts of the historical role of libraries as an intellectual community and institution of learning (Freeman et al. 2005). This evolution has grown primarily to engage learners in the development of critical thinking. Hussain and Nisha (2017), noted that researchers have not agreed upon a specific definition of makerspace. Makerspace began as a challenge for the maker movement to be creative and innovative (Woolls 2018), as a source of entrepreneurial innovation (Dougherty 2012; Van-Holm 2015), to transform the educational system (Halverson and Sheridan 2014), and as an impetus for industrial revolution where individuals became entrepreneurs by transforming their idea(s) into a product(s) (Anderson 2012). However, the predominant concept of makerspace is the encouraging sites, encompassing physical facilities where individuals can utilize tools and technology to share, learn, innovate and be creative (Hynes and Hynes 2018; Sheridan et al. 2014). The tools, materials and space provides the technical support to the users of makerspace, while the creative learning platform offers opportunity for peer learning. Therefore, makerspace has great potential to create numerous ways for students to learn and advance their education. Although the makerspace may differ in its functions and available facilities and equipment, because of varied funding (Baichtal 2011), the tendency for student to utilize the space is increased with greater perceptions of its usefulness.

Makerspaces are characterized as "formal or informal locations for creative output in art, science, and engineering, where individuals of all ages merge digital and physical technology to explore ideas, gain technical skills through cooperation based on their interests, and create new things" (Sheridan et al. 2014, p.1). In another study of two library makerspaces by Li (2021), 21 participants actively sought out, used, and shared information. This emphasized the importance of collaborative information and tinkering behaviors in makerspace use. On the use and awareness of makerspace in the library among professional librarians in India, it was reported that 51.6 percent of the library makerspace offer seminar/workshops/conference for students; 68.9 percent of the respondent are using these makerspace facilities for research and academic commitment; and 36.0 percent of the respondents understood the importance of library makerspaces and assessed them as valuable (Hussain and Nisha 2017).

To emphasize the perceived benefits of makerspace in academic libraries in Nigeria, Okpala (2016) had proposed a draft guide in establishing library makerspaces in Nigerian universities as focal meeting points for the university community, with the hope for a new positive turn to better the Nigerian educational system. Given the considerable benefits that makerspace would appear to offer, it would seem very important to understand what influences the acceptance and use of makerspace so that educators may improve the likelihood of success when introducing the use of makerspace in the context of Nigeria. More recently, Osawaru, Dime, and Okonjo (2020) investigated the perceived benefits and challenges of makerspace in Nigerian academic libraries. Their findings revealed that the para-professional and professional librarians were well aware of the benefits of makerspaces, however, poor funding and high cost of equipment were reported as the major challenges encountered in the adoption of makerspace in Nigeria. Similarly, Rhima (2021) revealed that the librarians in university libraries in South-South, Nigeria understood the concept of makerspace and the benefits that could be gained by learners, however they also reported that none of the universities had embarked on the development of a makerspace in the university library, citing cost as the main challenge. It was recommended that librarians should make a deliberate effort to enhance the makerspace service.

Makerspace as a Learning Environment

Makerspace is considered an irreplaceable learning environment, which has the potential to revolutionize the educational system through pedagogy and learning (Fleming 2015). This has generated the attention of scholars, policymakers, entrepreneurs, and practitioners to acknowledge the significance of learning diversity through collaboration (Vinodrai, Nader and Zavarella 2021). Learning in the makerspace allows students to choose from a variety of learning opportunities to improve their critical thinking and problem-solving skills. The Library as Incubator Project (2012) defines makerspaces as, collaborative learning environments where people come together to share materials and learn new skills, and concludes that, makerspaces are not necessarily born out of a specific set of materials or spaces, but rather a mindset of community partnership, collaboration, and creation." (Wang et al. 2016, p. 4). Therefore, a makerspace environment allows learners to dabble in a pedagogical mix of subject areas that values collaboration.

The concept of tinkering derives from the constructionist theories of learning, which focuses on hands-on activities in the pursuit of being, becoming, doing, and knowing (Bevan et al. 2015). According to Bevan, Petrich and Wilkinson (2014), makerspace users were learning according to the Tinkering Learning Dimensions Framework (TLDF) structure, which incorporates observable attributes or dimensions: initiative and intentionality, social scaffolding, developing understanding and learning engagement. Within the context of the current study, learning engagement and social scaffolding will be considered in the research framework as these constructs have support from previous literature on the effect on perceived usefulness.

In understanding the pedagogical practice of instructors in makerspace and how it influences student learning, Otieno (2017) revealed that the instructors' pedagogical practices are consistent with the constructivist learning framework for the twenty-first century. He further explains that "making and tinkering" in the makerspace do contribute to learning. The findings were mainly from the instructor's perspective, thus Otieno recommended more empirical studies from students' point of view to support the evidence of learning happening in the makerspace. Tomko et al. (2018) believe that learners not only develop social skills, but also develop their academic competencies through making activities, whilst going through real-world life experiences or hands-on activities in the makerspace.

Motivation and the Makerspace

Motivation as a multi-dimensional construct, evolves from various sources that include emotions, cognitions, needs, and environmental consequences, it also refers to any influence that boosts and directs the performance of an individual (Reeve and Halusic 2009). In the discipline of education, motivation is regarded as a key determining factor of learning. According to Ryan and Deci (2017), self-determination manifests itself in motivation in a continuum, thus resulting in: (i) amotivation (lacking the intent to act-almost no self-determination) to (ii) extrinsic motivation (varying degree of autonomous regulated behavior) to (iii) intrinsic motivation (highly autonomous behavior).

SDT generally utilizes theory of motivation that consists of basic needs, causality orientations, cognitive evaluation, goal contents, and organismic integration theory (Vansteenkiste, Niemiec and Soenens 2010). Research indicates that SDT presents a basis for sympathetic intrinsic motivation (Vansteenkiste and Sheldon 2006). It offers certain indications that provide encouragement and help for the growth of learning (Ryan and Deci 2017). Due to its focus on intrinsic and extrinsic motives related to learning, the theory is based on the idea that the motivation of humans is connected to the basic psychological needs for autonomy, relatedness, and competence.

According to Gilal et al. (2020), this theory indicates that an individual learner naturally has intrinsic motivation that can be displayed in curiosity-based performances, searching for optimal experiences, and discovering new perspectives. Therefore, a learner who internalizes the perceived usefulness of makerspace into their value is more intrinsically motivated to learn. This implies that SDT is a theoretical approach that offers the potential to motivate learners to develop flexible understanding and lifelong learning skills. Hilton et al. (2018) in their study of engineering students' use of makerspace and its effect on design self-efficacy, found that students actually needed to be motivated to use the makerspace. They reported that the " highly motivated students tend to join makerspaces and that students who chose to become involved have increased confidence in their design ability and expect more success" (p.1). In psychological research, the distinction between intrinsic and extrinsic motivation is generally accepted. Therefore, intrinsic motivation is understood as a construct reflecting the human propensity to learn (Ryan and Deci 2000), for example, a satisfying and enjoyable activity is intrinsic motivation. Whereas extrinsic motivation means that the individual is doing an activity to achieve some outcome and perceived it as useful. Researchers advocated that perceived usefulness in the technology acceptance model is an example of extrinsic motivation (Davis, Bagozzi and Warshaw 1992), and is the key driver of behavior and intentions to use makerspace. That is if a learner perceives the makerspace learning environment to be useful, the learners are more likely to have an extrinsic motivation to use the services, but the extent to which they are involved in the makerspace to complete the assigned task is predominantly an intrinsic motivation. Thus, in this study intrinsic motivation is investigated as an antecedent to perceived usefulness.

There is a substantial relationship between the basic psychological need of users and the makerspace environment. Based on SDT, Han et al. (2017) identified factors that encouraged the continuance intention of makerspace use by focusing on users' psychological needs of autonomy, relatedness, and competence. They found that as psychological needs were fulfilled, they significantly influenced intrinsic motivation, which ultimately influenced makerspace continuance intention. Similarly, Benjes-Small et al. (2017) evaluated the success of makerspace in an academic library and found that the majority of the respondents (84%) indicated positive responses and high usage of makerspace. The study recommends having a sustainable model to enable staff to work within their boundary and to ensure creative autonomy for the users.

Perceived Usefulness of Makerspace

Harron and Hughes (2018) regard makerspace as a technological innovation that is more likely to be accepted by individual learners when they perceive the makerspace to be useful. Two constructs (perceived ease of use and perceived usefulness) are widely used in the literature to study the mindset of users towards the use of technology (Venkatesh and Bala 2008). Over time, several studies have indicated that perceived ease of use did not have a significant direct relationship to the use of technology (Akther and Nur 2022; Unal and Uzun 2021). It is argued by researchers that perceived ease of use is not critical for uncomplicated technologies and it might not be the ultimate concern one reflects on when using a technology (Sun 2010). A study by Basuki et al. (2022) establishes that perceived usefulness is a more reliable indicator of users' behavioral intention to use different technologies in different settings.

Perceived usefulness according to Davis (1989) refers to "a degree to which a person believes that using a particular technology would enhance his or her job performance" (p. 4). Adapted from this definition, the perceived usefulness of makerspace in this study is defined as the extent to which a learner believes that using makerspace would enhance his or her learning performance. In line with the SDT, where learners adapt specific technology because of intrinsic motivations, this study considers perceived usefulness as a learner's external motivation that encouraged him or her to evaluate the advantages of a particular technology. Therefore, perceived usefulness communicates the outcome of makerspace usage.

Moorefield-Lang and Coker (2019) found that students perceived makerspace as a useful and remarkable space that allows bringing out their creative initiative to 'make', or in solving a particular problem using a tool. Interestingly, Keshinro and Oyewole (2021) investigated the influence of perceived usefulness on the use of school library makerspace in Nigeria. Their findings revealed that most of the students perceived library makerspace as useful and had a positive attitude towards innovation. Also, the relationship between perceived usefulness and the use of library makerspace was found to be statistically significant. The authors further recommended the use of various motivations to encourage students in the use of library makerspace. Therefore, the tendency for the students to utilize makerspace increased with greater perceptions of its usefulness.

RESEARCH MODEL AND HYPOTHESES

This study suggests a research model to investigate the effect of intrinsic motivation and learning dimensions on the perceived usefulness of makerspace among Nigerian university students. The Self-Determination Theory (SDT) and the Tinkering Learning Dimensions Framework (TLDF) form the basis of the research model. The theory proposes that the adoption of intrinsic motivation depends on the satisfaction of three basic psychological needs: the need for relatedness, competence, and autonomy. Relatedness refers to the desire to feel connected to others, while competence refers to the desire to feel effective in attaining valued outcomes. The desire to self-initiate and self-regulate own behavior is considered as autonomy.

The tinkering learning dimension is developed specifically for after-school programs to establish the learning dimension. Bevan et al. (2014) observed that "investment (of time, thought and emotion) was an important construct for engagement" (p.10). According to Fredricks, Blumenfeld and Paris (2004), the engagement dimension of learning involves behavioral, cognitive, and emotional aspects involved in an activity. Many formal and informal learning locations seek to create a social environment in which learners help and encourage one another to solve a problem, this is important in makerspace where people collaborate and investigate an inquiry (social scaffolding).

The application of SDT and TLDF can serve as a much-needed unifying conceptual understanding of the factors leading to the perceived usefulness of library makerspace in university libraries. The research model (Figure 1) depicts the relationships between the intrinsic motivation construct which is measured based on the three basic psychological needs for autonomy, relatedness, and competence, and perceived usefulness of library makerspace. Inline with the maker and tinkering characteristics of the learning environment in which the activities of the makerspace happens, the effect of learning dimension of the students involved in makerspace is measured using constructs of social scaffolding and learning engagement. These are considered the mediating factors that influence the effect of intrinsic motivation on perceived usefulness. The formulation of each hypothesis of the research model (Figure 1) is detailed in the subsequent paragraphs.

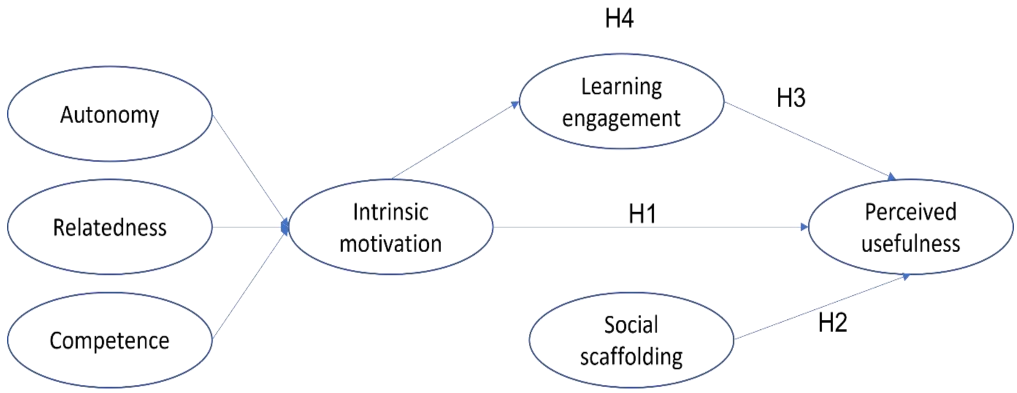

Figure 1: Research Model and Hypothesis Development

Several studies indicate a significant positive relationship that exists between intrinsic motivation and perceived usefulness (Fagan, Neill and Wooldridge 2008; Sun and Gao 2020). According to field evidence, Maheshwari (2021) discovered that intrinsic motivational factors have a significant influence on perceived usefulness when determining the factors influencing students' intentions to engage in online learning in Vietnam. Therefore, it is assumed that intrinsic motivation will positively drive the decision-making process to act independently within the library makerspace learning environment. This postulated that:

H1: Intrinsic motivation has a positive effect on the perceived usefulness of library makerspace.

The proper interaction among learners via scaffolding can provide a significant increase in learning outcomes. Based on the structural model results, Mulhem and Almaiah (2021) discovered that incorporating the scaffolding learning strategy into an educational mobile game had a significant effect on students' perceived usefulness and behavioral intention to use. When multiple tools are available within the makerspace, the use of social scaffolding is assumed to help learners to collaborate on what they want to use. This, in turn, is perceived as useful.

H2: Social scaffolding has a positive effect on the perceived usefulness of library makerspace.

Scholars expect learners to be more motivated and engaged in learning environments that adds value and are seen as useful (Ryan and Deci 2000). It was discovered from previous research that engagement and perceived usefulness demonstrated a positive relationship (El-Sayad, Md Saad and Thurasamy 2021; Hu et al. 2018). Interestingly, An and Han (2020) demonstrated that user engagement mediates the relationship between intrinsic motivation and the creation of customer value/usefulness. Therefore, to maintain the usefulness of library makerspace, learner behavioral engagement should be considered as a better indicator to perceive the usefulness of library makerspace. This postulated that:

H3: Learning engagement has a positive effect on the perceived usefulness of library makerspace.
H4: Learning engagement positively mediates the relationship between intrinsic motivation and perceived usefulness of library makerspace

METHODS

The study used the survey research design. Data was collected using a survey questionnaire as the research instrument. This enables the authors to study both small and large populations by selecting a sample representing the population, and at a relatively low cost (Engel and Schutt 2012). The population for the study came from two federal universities (A and B) in Nigeria which had established a makerspace.

Using Krecjie and Morgan (1970)'s recommendation, 364 respondents would be needed for reliable analysis of the population of 6329. To eliminate subjectivity, which truly represents all the characteristics of the research population, a random sampling technique was employed to collect data from a sample of 364 respondents. The sample list was generated using an online sample calculator known as a research randomizer from the total population of the universities. However, for each university, a proportionate stratified sampling technique was used to determine the number of questionnaires to be distributed based on their populations (Uni A. 2924/6329 X100 = 46.2 % (n=168), and Uni B. 3405/6329 X 100 = 53.8% (n=196), respectively). To collect the data, the first author of this study used the name list of registered makerspace users. Based on this, each registered name was assigned a unique number to ensure that each respondent is represented equally in the population's sample. The questionnaires were distributed with the help of two field assistants. A total of 323 usable responses (89% response rate) were used for data analysis. The research instrument consisted of 12 items to measure intrinsic motivation, 9 items for learning dimensions and 4 items for perceived usefulness (see Appendix). All item were measured on a 7-point Likert-type scale (1-strongly disagree to 7-strongly agree). The source for operationalization of items for each construct are depicted in Table 1. Structural Equation Modeling (SEM) was employed to test all hypotheses concerning the structures underlying the set of variables, as projected in the research model.

Table 1: The Operationalization of Constructs and Sources of the Instrument

Constructs	Source for operationalization of items for each construct
Intrinsic motivation	
Autonomy	Standage,Duda and Ntoumanis (2005); Xi and Hamari (2019)
Relatedness	Xi and Hamari (2019)
Competence	Xi and Hamari (2019)
Learning dimensions	
Learning Engagement	Bevan et al. (2014); O'Brien, Cairns and Hall (2018)
Social scaffolding	Bevan et al. (2014); Cho and Cho (2016)
Perceived usefulness	Davis (1989)

Factor analysis was computed among a set of the observable variables, namely, intrinsic motivation and learning dimension, and most of the items correlated on at least .3 with the Kaiser-Meyer-Olkin Measure of Sampling Adequacy of .797, .836, and .845 for intrinsic motivation, and .859, .791 for learning dimension respectively, which is greater than the recommended value of .5 (Tabachnick, Fidell and Ullman 2007). The Bartlett's test of sphericity for intrinsic motivation was significant at $\chi2$ (6) = 533.492, $p < .05$; $\chi2$ (6) = 830.117, $p < .05$; and $\chi2$ (6) =722.656, $p < .05$; and for learning dimensions $\chi2$ (10) = 858.768, $p < .05$; and $\chi2$ (6) = 515.953, $p < .05$–respectively. This achieved statistical significance, providing the factorability of the correlation matrix as according to Bartlett (1954). The commonalities of the items were greater than .5, exceeding the benchmark of .3 as suggested by Pallant (2007). Similarly, diagonals of the anti-image component matrix were all above .5, confirming that most of the items shared some common variance with other items. Considering the overall indicators, factor analysis was conducted with no items deleted.

Principal Components Analysis

The initial Eigenvalues for intrinsic motivation showed that the three-factor explained 2.738%, 3.120%, and 2.969% of the variance. The factor solutions explained 68.46%, 77.99%, and 74.23% variances. Similarly, the initial Eigenvalues for learning dimensions revealed that factor explained 3.365%, and 2.698%, of the variance, and the factor solutions explained 67.293% and 67.440% variances.

Reliability and Validity of Measures

Reliability analyses showed that all measures had satisfactory good alpha coefficients ranging from .795 to .906, respectively (Table 2). All items with acceptable loadings factors were retained and used in further analysis.

Table 2: Reliability of the Constructs

Factors	Cronbach Alpha α	Number of items
Autonomy	.846	4(AUT1- AUT4)
Competence	.906	4(COM1- COM4)
Relatedness	.884	4 (REL1 – REL4)
Learning Engagement	.875	5 (ENG1 – ENG5)
Social scaffolding	.838	4 (SCF1-SCF4)
Perceived usefulness	.795	4(PUM1-PUM4)

Model Evaluation

The proposed structural model was estimated using Structural Equation Modeling (SEM) with SPSS Amos version 21. Maximum Likelihood Estimation (MLE) was used to generate the estimated parameters of the respective factors. This was done after first and second-order measurement models for each scale and the integrated measurement model were evaluated using confirmatory factor analysis (CFA). In addition, some fit index such as relative chi-square (CMINDF: the chi-square/degree of freedom), Tucker Lewis Index (TLI), Comparative Fit Index (CFI), Incremental Fit Index (IFI), Normed Fit Index (NFI) and Root Mean Square of Error Approximation (RMSEA), are used in assessing model fit. A good model is indicated by RMSEA value of less than or equal to 0.05. The recommended values of these indices are between 0 and 1.0, with values greater than .90 indicating higher levels of goodness-of-fit (Kline 2005). Given that, the degree of freedom of the majority of these fit indices is computed by using ratios of the model chi-square and the null model chi-square. An earlier convention of the TLI, and the IFI use above .90 as a cut-off for good fitting models. However, there appears to be some agreement now that this value should be increased to around .95 (Hu and Bentler 1999; Kline 2005). Values approaching 1 are justified as a good model fit. The RMSEA with a recommended value of < 0.08 is acceptable (Hair et al. 2010). Modification indices (MI) were used to get the model fit with the index of >.4 considerably this will contributes significantly to the goodness-of-fit index (Byrne 2016).

Normality

The findings of the distribution of data indicated that the skewness and kurtosis of all variables fell within the range of -3.0 to +3.0 of the normality assumption by analyzing the data distribution of the exogenous and endogenous variables. This indicates that the data is normal and can be subjected to further analysis.

Confirmatory Factor Analysis (CFA)

The Confirmatory Factor Analysis (CFA) was used to identify the factors that account for the variation and covariation and factor loadings among a set of indicators. The proposed measurement model was tested based on the findings of CFA results for each dimension. The model was measured by the intrinsic motivational factors, learning dimensions, and perceived usefulness. Initially, the estimated model did not give a satisfactory model fit until when modification indices (MI) were employed. However, one item from the perceived usefulness of makerspace (PUM2) failed to meet satisfactory parameter loading of < .5, therefore, the item were not considered for further analysis. The final measurement model has loaded satisfactorily with CMINDF = 1.439, GFI =.922, TLI =.975, CFI =.979, RMSEA = .037, and p = .000. The measurement model shows that the data fit the model well, indicating that the model fit has been fulfilled.

Convergent and Discriminant Validity

According to the result of the measurement model, the composite reliability (CR) of intrinsic motivation is 0.837, 0.912, and 0.884. For the two learning dimensions it is 0.842, and 0.880 respectively and for the perceived usefulness of makerspace it is 0.870. According to Fornell and Larcker (1981), this supports clear evidence of convergent validity. Equally, the value of discriminant validity was fulfilled and above .5 (Table 3) as recommended by Hair, Gabriel and Patel (2014). The results for convergent and discriminant validity as well as other psychometric properties have provided a satisfactory reason to move further to the structural model.

Table 3: Assessment of Discriminant Validity

	CR	AVE	MSV	ASV	SCF	AUT	COM	REL	ENG	PUM
Social scaffolding	0.842	0.573	0.596	0.385	0.775					
Autonomy	0.837	0.566	0.469	0.348	0.526	0.752				
Competence	0.912	0.721	0.469	0.307	0.464	0.685	0.849			
Relatedness	0.884	0.657	0.477	0.418	0.661	0.643	0.605	0.810		
Learning engagement	0.880	0.598	0.572	0.396	0.634	0.567	0.534	0.631	0.773	
Perceived usefulness	0.870	0.691	0.596	0.420	0.772	0.508	0.446	0.691	0.756	0.832

Assessment of the Structural Model

SEM Amos version 21 was used to test the constructs in the model. The error variance, modification indices, and residual covariance were used to evaluate the model (Figure 2).

Based on the Maximum Likelihood Estimation (MLE), the model fit of the data was CMINDF = 2.183, GFI = .893, CFI = .942, IFI = .942, TLI = .933, RMSEA =.061. and p < .000. The indices value of both AGFI and CFI are within the acceptable limit, they indicate more than the cut-off of 0.8, and 0.9, respectively. Because of the high correlation among the variables in the proposed path model, the low value of GFI is acceptable (Hair et al. 2010). CMINDF indicates a good model fit as well as RMSEA smaller than .08 (Kline 2005). Therefore, the proposed model shows that the data fit the model well, indicating that the model fit has been fulfilled.

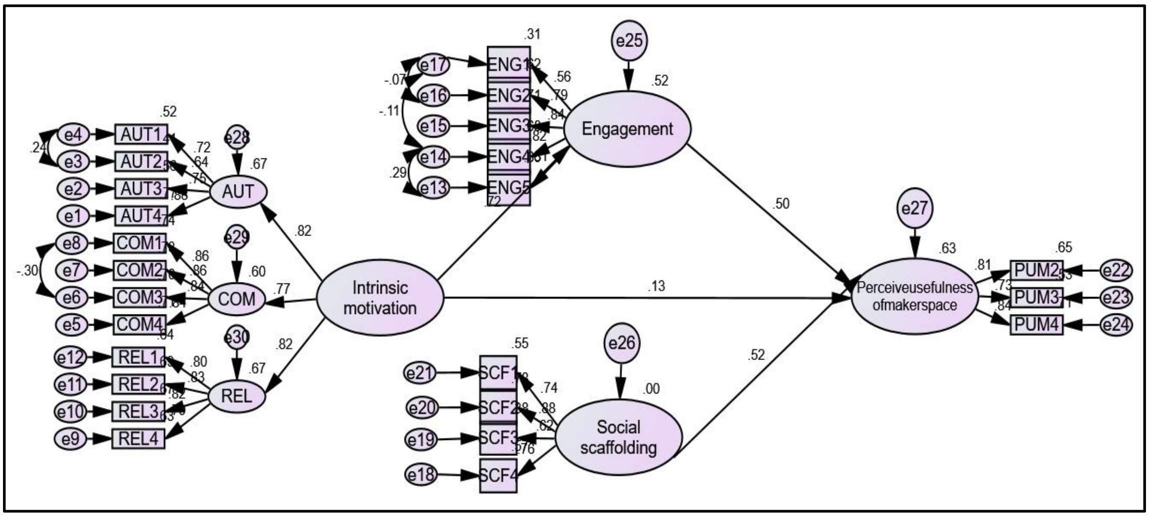

Figure 2: A Path Model of the Research

Hair et al. (2010) recommend using standardized regression weight to compare the relative effect of each exogenous on endogenous variable (Table 4). The intrinsic motivation to perceive usefulness of library makerspace was found to be statistically not significant at p > .05 (β = .133, CR = 1.555, p = .120), The relationship between social scaffolding and perceived usefulness of makerspace was found to be statistically significant (β = .434, CR = 9.780, *p* <.000), as was the result of engagement to perceive usefulness of makerspace (β = .434, CR = 5.981, *p* < .000).

Table 4: Standardized Estimates of the Structural Model

Path A			**Estimate**	**S.E.**	**C.R.**	**P**	**Sest.**
Perceive usefulness of makerspace	<---	Intrinsic motivation	.133	.085	1.555	.120	.129
Perceive usefulness of makerspace	<---	Social scaffolding	.434	.044	9.780	***	.517
Perceive usefulness of makerspace	<---	Learning engagement	.434	.073	5.981	***	.500

Table 5 present the result of the total, direct, and indirect effects of the structural model. The result of the indirect effect indicates that learning engagement has fully mediated the relationship between intrinsic motivation and perceived usefulness of library makerspace. The findings support the prediction of the research. Table 6 presents the summary of the hypotheses testing. The direct positive effect of intrinsic motivation on perceived usefulness is not supported.

Table 5: Standardized Total, Direct, and Indirect Effects of the Structural Model

Path B	**Total effects**	**Direct effects**	**Indirect effects**
Intrinsic motivation	.490*	.129**	.361*
Learning engagement	.500*	.500*	
Social scaffolding	.517*	.517*	

*p<.0005 **p<.05

Table 6: Hypothesis Testing

	Research Hypothesis	Results
H1.	*Intrinsic motivation has a positive effect on the perceived usefulness of library makerspace*	Not Supported
H2.	*Social scaffolding has a positive effect on the perceived usefulness of library makerspace.*	Supported
H3.	*Learning engagement has a positive effect on the perceived usefulness of library makerspace.*	Supported
H4.	*There is a statistically significant relationship between intrinsic motivation and the perceived usefulness of library makerspace mediated by learning engagement.*	Supported

Based on the results of the hypothesis it can be inferred that intrinsic motivation does not have a statistically significant effect on perceived usefulness of makerspace. On the other hand the learning dimensions, both social scaffolding and learning engagement reveal a significant direct effect on perceived usefulness of library makerspace. Both these dimensions also mediated the relationship between intrinsic motivation and perceived usefulness of library makerspace.

DISCUSSION

The findings of this study has revealed several theoretical and practical implications for the use of library makerspace among university students. Assuming perceived usefulness as an antecedent of use, this study examined the direct effect of intrinsic motivation on students' perceived usefulness of makerspace in their university library. Prior findings of studies have reported a positive direct effect of intrinsic motivation (Maheshwari 2021; Sun and Gao 2020), however, in this study it was unexpectedly found that there is no direct positive effect (Hypothesis H1) of intrinsic motivation on perceived usefulness of library makerspace. However, the relationship is mediated by learning engagement (Hypothesis H4).

Mediating effect of learning engagement between intrinsic motivation and perceived usefulness is consistent with An and Han (2020)'s findings that established the mediating effect of user engagement on the relationship between intrinsic motivation and the creation of customer value/usefulness. Ryan and Deci (2000) supported this relationship by stating that learners engage in activities of interest once they are intrinsically motivated to develop, learn, and expand their skills. On the other hand, lack of motivation often leads to disengagement and a loss of interest. This implies that engagement in makerspace environment must be maintained. Within the framework of SDT, motivation is associated with the satisfaction of students' psychological needs. Giving the user the autonomy to control the choices made in the use of a library makerspace, having the capability to perform at the makerspace, while interacting with others does not directly influence the users' perception of the usefulness of the library makerspace unless there is positive learning engagement or in other words the user has a sense of fulfilment or gratification that he/she has experienced learning in the makerspace environment. This can be interpreted as directed or intentional use of makerspace for learning to happen and can contribute towards perceived usefulness of the library makerspace which will then lead to actual use. It is expected that satisfying the need to be connected within the maker learning space influences the level of intrinsic motivation, and it is difficult for a student to develop intrinsic motivation if they are not confident enough to participate in makerspace activities. Being actively engaged in learning within the environment of a makerspace requires students to be frequently involved in the activities and their experiences are considered by them to be rewarding. Given the educational value of makerspaces, both students and mentors feel valued in developing a culture of maker activities and promoting skills, problem-solving, and evidence-based thinking relevant to the information-rich twenty-first century (Blackley et al. 2017; Vongkulluksn et al. 2018). The participants of makersapces are allowed to shape their professional identities. This non-traditional method also contributes to creating a general environment where mentors and students experiment without fear.

Although the maker movement is rooted in informal learning, the existence of most makerspaces in learning institutions are directly involved in educational activities. Thus, the expectation of the user is to obtain some level of learning. This led to the use of mentors or tutors in the makerspace that assisted learners to achieve certain learning goals beyond their capabilities if left unattended. In this study, social scaffolding is found to have a direct positive effect on perceived usefulness of library makerspace (Hypothesis H2). This concurs with Mulhem and Almaiah (2021) who found that incorporating the scaffolding learning strategy into an educational mobile game improves students' learning effectiveness. Therefore, providing explicit social scaffolding during the learning phase would have a significant influence on learning outcomes, thus influencing users' perception of usefulness of the library makerspace. When users are made to feel the support (by instructors/facilitators) and provided the opportunity to interact with others to achieve a common learning goal, they find the environment more meaningful and perceive the activity to be useful. Multiple scaffolding options that emphasize the users' skills in using the available tools within the makerspace should be a continuous effort towards directed self-learning.

This study has demonstrated that there is a statistically significant relationship between engagement and perceived usefulness of library makerspace in Nigerian academic libraries, leading to support hypothesis H3, which is consistent with previous research (El-Sayad, Md Saad and Thurasamy 2021; Hong et al. 2021). Underlining the learning engagement may reinforce learners' perception, which may, in turn, encourage the application of renewed pedagogical practice in makerspace.

The study has developed a measure for the perceived usefulness of makerspace in Nigerian universities. The research framework can be used to examine the effect of intrinsic motivation and learning dimensions on users' perception of makerspace usefulness, which would then encourage increased use of makerspaces in Nigerian universities. The measurement instrument in this study is the groundwork for future studies to validate and test the relationship between the constructs, especially the direct influence of intrinsic motivation.

CONCLUSIONS

This study has limitations in the number of makerspaces investigated, however it has highlighted the significance of a research model based on the SDT and TDLF to understand the motivating factors that influence users perceived usefulness of library makerspace and the mediating role played by learning dimensions. As the maker movement is about making and tinkering and learning through these active and social interactions, this understanding can help university makerspace authorities to tackle the right motives to increase use of library makerspace through increased positive perception of the usefulness of the makerspace. This study has demonstrated how basic psychological needs for competence, autonomy, and relatedness (intrinsic motivation) indirectly influence perceived usefulness of library makerspace through learning engagement. Likewise, social scaffolding and engagement can have a direct positive influence on the perceived usefulness of makerspace. To the best of the authors' knowledge, this is the first attempt to apply the theories to this context, therefore, the findings must be replicated and considered in different contexts and setups.

As has been shown, when a makerspace environment has a variety of tools available, the use of social scaffolding may help students collaborate on which tools to use. This may encourage interaction among makerspace users to collaborate on projects. Students will be able to advance their current knowledge and skills in the makerspace environment to levels previously unachievable in other learning environments, and the management may increase learners' perceptions of the library makerspace to be more useful by involving students in more realistic interactions.

Given the study's limitations, the outcomes are then restricted to these two universities. Due to the reliance on quantitative data analysis in this investigation, other researchers may use a combination of methodologies to gain a deeper understanding of the variables. Since the data were gathered through a self-administered questionnaire, it would be interesting if subsequent research could make use of longitudinal data to assess makerspace effectiveness over the long term. There is a need to replicate and strengthen the hypothesis before it might advance from a tentative to a reliable postulation. More research could be done to determine other variables, such as the budget constraints of the space to perceive usefulness.

The instructors or teaching faculty, in collaboration with library management, should regularly speak to the students about the benefits of using makerspace and they should make sure that the students have a designated time to visit the makerspace environment. Through regular workshops and seminars that raise awareness of what the makerspace is all about and its benefits, it will be easier to connect the student to perceive the usefulness of the library makerspace, which will influence the utilization of the space. When planning their activities to develop pedagogical practice, management should base their decisions on how people learn to provide instructional scaffolding that will improve learning. Following that, library management may use the findings of this study to improve their understanding of strategies for motivating learners to perceive the usefulness of makerspace in academic libraries in Nigeria.

Finally, if management carefully plans and effectively implements the study's findings, it will provide opportunities for learners to tap into their desires for innovation and creativity, which is an essential component to the growth of any sector, including the library makerspace environment.

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AUTHOR DECLARATION

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APPENDIX

INSTRUMENT ITEMS

Instructions: As you read the following, please indicate the extent to which you think that indicator is important to influence the perceive usefulness of makerspace in Nigerian universities.

- If you feel a criterion is "Strongly disagree", then circle number "1".
- If you feel a criterion is of "Strongly agree" circle number "7".
- If your feelings are less strong, circle any of the numbers between "1" and "7"

Intrinsic motivational factors	
Autonomy *(People need to feel in control of their behavioral choice)*	
AUT1	When I visited makerspace, it is because I want to use it
AUT2	I feel free to express my ideas and opinions in a makerspace environment
AUT3	I feel free to use makerspace tools.
AUT4	I feel free to decide what activities to do in a makerspace environment
Competence (*Individual's perception of being capable of performing an activity effectively and achieving a specific outcome*)	
COM1	I am satisfied with my performance when I visited the makerspace environment
COM2	I think that I am pretty good when I visited makerspace environment
COM3	I feel like a competent person when I visited makerspace
COM4	I feel like an expert in the makerspace environment
Relatedness (*People need to experience a sense of belonging and attachment to other people*)	
REL1	When I visited makerspace, I feel a sense of contact with a participant who cares for me, and whom I care for
REL2	When I visited makerspace, I feel supported by other participants.
REL3	When I visited makerspace, I feel that I am a valuable person to other participants.
REL4	When I visited makerspace, I feel that I am understood by other participants
Learning dimensions: Indicators of tinkering learning dimension framework (TLDF)	
Engagement (*This is the positive dedication and fulfillment of interest in related works, satisfaction, and absorption*)	
ENG1	I frequently engage in makerspace training
ENG2	Learning makerspace activities is attractive
ENG3	My experience learning makerspace is rewarding
ENG4	Learning makerspace activities is aesthetically appealing
ENG5	The time I spend using makerspace just slips away
Social Scaffolding (*It is the social environment that permits assistance, and interaction from others to advance self-learning*)	
SCF1	I can offer help or borrow ideas and tools for problem-solving at makerspace
SCF2	I feel happy in producing work that physically interacts with others' work in makerspace
SCF3	I feel active to participate in makerspace discussions or ask a question to other participants
SCF4	If learners' general interaction is low, the instructor encourages us to participate actively in makerspace interaction.
Perceive usefulness of makerspace	
Perceive usefulness *(The degree of a student's belief that using a makerspace learning environment would enhance his/her job performance)*	
PUMI	Using the makerspace enables me to accomplish my work/learning more quickly.
PUM2	Using the makerspace would improve my work/learning performance.
PUM3	Using the makerspace would enhance my work/learning effectiveness.
PUM4	Using the makerspace can increase my productivity when performing my work/learning.