2023 Jurnal Kejuruteraan, Teknologi dan Sains Sosial
Volume 9 Issue 1, July 2023, e-ISSN: 27166848

FUTURE LEARNING ECOSYSTEM DESIGN AFFORDANCE TOWARDS EDUCATION 4.0

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ARTICLE INFO

Article history:
Received
13 June 2023
Received in revised form
15 July 2023
Accepted
25 July 2023
Published online
31 July 2023

***Keywords**:*
Learning space; Education 4.0; Afordances; Self-regulated learning; Connectivism learning theory

ABSTRACT

The 21st century is embraced by the advancement of technology in every discipline. The immense development of Information and Communication Technology (ICT), Artificial Intelligence (AI), digitization, automation, and the Internet of Things (IoT) articulate the term Education 4.0. For learning and teaching development, these advancements have aided educators to accomplish the promise of "anytime, anywhere" learning. Moreover, the infusion of ICT in education nurtures a new learning theory so-called Connectivism learning theory. The study emphasizes students' desired learning ecosystem design affordance for collaborative and self-regulated learning. The study is centred on a survey questionnaire that was engaged by 580 diploma students from Polytechnics. The findings reveal that students preferred eight design affordances in establishing an ideal learning ecosystem. The study permits a vital insight into redesigning higher education institution learning spaces.

1. Introduction

Presently, the outlook of the higher education scenario known as an academic evolution is extensively unprecedented (Ramu et al., 2019; Salinas-navarro et al., 2023; Valtonen et al., 2021). Furthermore, the diligent advancement of ICT confronts the term Industrial Revolution 4.0. The evolving latest learning theory so-call "Connectivism" has encapsulated the pedagogy (Hanh et al., 2021). Higher education institutions currently are altering their old-school learning space into technology-enabled academic learning space to expedite innovation in teaching and learning and improve learning experiences (Ramu et al., 2021; Salinas-navarro et al., 2023; Walcutt & Sae Schatz, 2020; Wangyal & Poh, 2019). Hence, higher education is now shifting away from boundaries into Next-Generation Learning Space (Ramu et al., 2020).

This research aims to distinguish an ideal learning ecosystem design affordances based on students' preferences. This study provides the research findings regarding space design aspects of higher education. It is in line with the expanding number of studies regarding the interconnection between physical learning space ecosystems, the latest learning theory, education 4.0, and 21st-century education (Vujovic et al., 2022). The digital native students are more independent in their learning undertakings and use ICT resources in assertive sufficient information. As matter of fact, emerging technologies not only alter formal education but also transform access to information and affect the soul of how the students think, interact, develop,

and collaborate. Unfortunately, the landscape of pedagogy has magnified. It embraces the complete spectrum of formal, informal and experiential learning (Viberg et al., 2021). The term "future learning ecosystem" coined by scholars demonstrates a transformation away from disconnected, episodic experiences and towards a curated continuum of lifelong learning (Walcutt & Sae Schatz, 2020).

Kim et al., 2019 stated that there is a provocation in how students perceived the new learning space which operates the learning process. Essentially, a desired and compatible campus ecosystem can be reconceptualized into a new learning landscape. Therefore, an authentic future learning ecosystem blueprint is mandatory to interpret the spatial implication of a new way of educating. As pointed out in the literature, due to Covid 19 pandemic and massive online learning, the current direction in designing education-building, consideration is given more to informal learning spaces, self-regulated, and collaborative learning compared to formal and enclosed learning spaces (Al-Mutairi, 2021; Bahasoan et al., 2020; Kamal et al., 2020). For this reason, the whole idea of learning altered from a place that delivers instruction way back in the 19th century into a setting that constitutes knowledge (Ramu et al., 2019). The conventional learning space layout is significantly correlated with the idea of "one-size-fits-all' without considering students' aspirations and needs (Bondie et al., 2019). In addressing this limitation, the new way of learning demands additional space so-called future learning ecosystem.

2. Literature Review

The term "learning ecosystem" is a specified place that leads learning namely formal and informal learning spaces. Furthermore, learning ecosystems are beyond a physical built environment (Beckers et al., 2016). Many researchers point out that 21st-century teaching and learning need to be performed in an environment that "promotes interaction and a sense of community which permit formal and informal learning". Consequently, this study addresses the profound design affordances that manipulate the learning ecosystem design. Teaching and learning are shifting in the 21st century. ICT technologies employed in the education system, namely, interactive whiteboards, individual learning spaces, wireless systems and mobile gadgets, and digital resources. Therefore, all these aspects are modifying the students learning undertakings. Thus, the conceptualization of the learning ecosystem needs to be flexible, creative, supportive and enterprising (Elkington & Bligh, 2019). Malaysia Education Blueprint (MEB) has suggested eleven strategic and operation shifts that are essential to attain the vision (Kementerian Pendidikan Malaysia, 2015). Education is a vital aspect towards accomplishing the nations' aims of developing a high-profit and knowledge-based population. Indeed, the latest ICT kits are always imposed with current teaching and learning properties. There is a sympathetic knowledge guideline that students preferably require to enhance in the 21st century. (Che KU Nuraini Che ku Mohd & Faaizah Shahbodin, 2015).

The theory of affordance was established by Gibson in 1966 and indicated that it was about "what it offers the animal, what it provides or furnishes, either for good or ill" (Masoudi et al., 2019). As mentioned by Gibson (1979) environment and animal complement each other so that a transactional relationship exists in both components. The idea of ecological perceptual psychology indicated that "human were inspired by the ecosystem and inspired the ecosystem". In this study, students recognise the learning ecosystem, that is shaped by the learning milieu. Essentially, in this study, affordances indicate the functionally learning milieu features. Students distinguish these features via action-based and perception-based. Therefore, affordances occur in various forms: objects, surfaces, substances, or places (Chaudhury, 2019). This theory

encompasses two primary mechanisms: i) students' actions and ii) students' perceptions. All the particulars obtained by the students in the learning milieu are essential for students' undertakings. Mostly, in studies concerning the student, academics often applied Gibson's theory of affordances to explore the operationalisation of students learning space perceptiveness (Chaudhury, 2019). The literature discovered that teenagers and adults own various methods of distinguishing environmental affordances. Hence, affordance is unique for each person and construct on human qualities and behaviour.

3. Methodology

The data collection was accomplished at Politeknik Sultan Idris Shah (PSIS). The respondents were chosen from the civil department by applying multistage probability sampling. The respondents (diploma students) were stratified into program and semester, which consisted of semesters one to five. Semester six is excluded due to industrial training. This study used simple random sampling, whereby, one class from each semester was selected. A total of 5 classes were selected from each program. The students' assents were obtained verbally since the participation was voluntary. The survey items were developed to acquire the data encompasses two parts. Part A involves students' demographic. Part B of the survey covers learning ecosystem design affordances. The survey items have been piloted twice in two groups (*n*= 5 and *n=6).* The rationale is to verify the clarity of the survey instruments. The items were reviewed by two expert reviewers to ensure the validity and reliability of the underlying dimension of students' future learning ecosystem design affordances. The two experts' reviewers were from the architecture and education disciplines. The reviewers found that a few items are ambiguous, rephrase, and the items needed to be bilingual. A pilot test was executed to safeguard the suitability, phrasing, arrangement, and instructions. Those students involved during the pre-test are excluded from the actual survey. After the pilot test, a few corrections were done to improve the items. After the second pilot test, the average time to answer the survey was reduced from 15 min to 10 min. The collected data was computed in the Statistical Package for Social Sciences (SPSS). Out of 580 respondents, 565 respondents completed the questionnaire, resulting in an overall response rate of 98%. The survey items were developed to distinguish the learning space design affordances, as shown in Table 1. Students are required to indicate their perceptiveness on the list of proportions, built on a five-point Likert scale ranging from 1 represents "strongly disagree" to 5 represents "strongly agree". Exploratory factor analysis (EFA) is for analysis of the smaller set of the factor structures of learning space design affordances that are best explained by its underlying items. In this research principal component extraction method and varimax rotation were used to produce the uncorrelated extracted factors with eigenvalues greater than 1.0. There are two statistical measures to examine the underlying items for each variable's extracted factor structure: standardized factor loading and Cronbach's alpha. The adopted cut-off value of standardized factor loading (l) is 0.05 and above (Hair et al., 2014), whereas Cronbach's alpha is 0.70 and above (Peterson, 2013).

Table 1: Operationalization of Future Learning Ecosystem Design Affordances

Affordances	Operationalization
Interaction (5 items)	The involvement of students in group and collaborative learning
Autonomy (4 items)	Personal control on what to do, where and when.
Privacy (5 items)	The level of control on interaction
Layout (4 items)	How the physical setting is utilized by students.
ICT Facilities (5 items)	The effectiveness of ICT facilities on campus
Comfort (12 items)	Conducive learning ecosystem
Aesthetic (4 items)	Aspects that enhance learning among students

4. Finding and Analysis

The future learning ecosystem design affordances comprised 39 items, namely: interaction affordances, autonomy affordances, semi-privacy affordances, privacy affordances, comfort affordances, ICT facilities affordances, aesthetic affordances and layout affordances (table 2). The Kaiser-Meyer-Olkin measure of sample adequacy index was 0.92. Meanwhile, bartlett's test of sphericity was significant with x^2 (703, n = 565) = 30,072.066, $p < 0.001$. Thus, this implies that the data were suitable for EFA. EFA attempts to identify factors that explain the pattern of correlation within a set of observed variables. Furthermore, EFA is also used for multivariate analysis of variance to cluster the variables into accomplishable numbers. The analysis distinguishes eight affordances extracted from EFA that represented the future learning ecosystem design affordances, namely: interaction, autonomy, semi-privacy, privacy, comfort, aesthetics, ICT facilities and layout. The items' loading ranged from 0.80 to 0.51, above the cut-off value of 0.50 as recommended by Hair et al., 2014. The EFA validated that all items are measuring the constructs loaded onto the respective factors, and excluded privacy contracts that were loaded onto two factors: privacy and semi-privacy factors. Table 2 shows Cronbach's α, eigenvalue values, cumulative variance explained, and the descriptive data. Consequently, eight factors extracted in this study are grouped as future learning ecosystem design affordances based on the Malaysian education learning context. Hence, those design factors help design an ideal future learning ecosystem that suitable for Malaysian students' learning culture. This study revealed that students demand privacy and semi-privacy learning spaces. Commonly, female students favour privacy space compared to male students. They would like to have their own little confined space with a high autonomy level (Elkington & Bligh, 2019; Masoudi et al., 2019; Xie et al., 2022; Zhang, 2019).

Table 2: Analysis of EFA

Affordances	Cronbach's	Eigenvalue values	M(SD)
Aesthetic	0.87	2.08	4.20(0.68)
Comfort	0.93	15.71	4.13(0.63)
Layout	0.79	1.00	4.01(0.67)
ICT facilities	0.90	2.69	4.00(1.03)
Interaction	0.77	1.21	3.63(1.03)
Privacy	0.80	1.14	3.80(0.94)
Semi-privacy	0.80	1.12	3.63(1.03)
Autonomy	0.80	1.76	3.30(0.93)

5. Conclusion

Those eight future learning ecosystem design affordances are developed in the local learning milieu (refer to Figure 1). Design affordances detailed in the literature are established outside of the Malaysian learning milieu. Those design affordances are established on seven attributes, namely, interaction, autonomy, privacy, comfort, aesthetics, ICT facilities, and layout. The study at Politeknik Sultan Idris Shah revealed that the privacy affordances requires to be listed in two separate entities: privacy and semi-privacy affordances, and correlated with local learning atmosphere. The private learning layout stated is personally assigned for female students in order toobtain additional personal space. Meanwhile, semi-privacy layout is correlated withalongside learning and self-regulated learning. Thus, this study discovered that there are eight design affordances required in designing future learning ecosystems. Consequently,a properly designed learning spaces can promote and enhance learning among students.

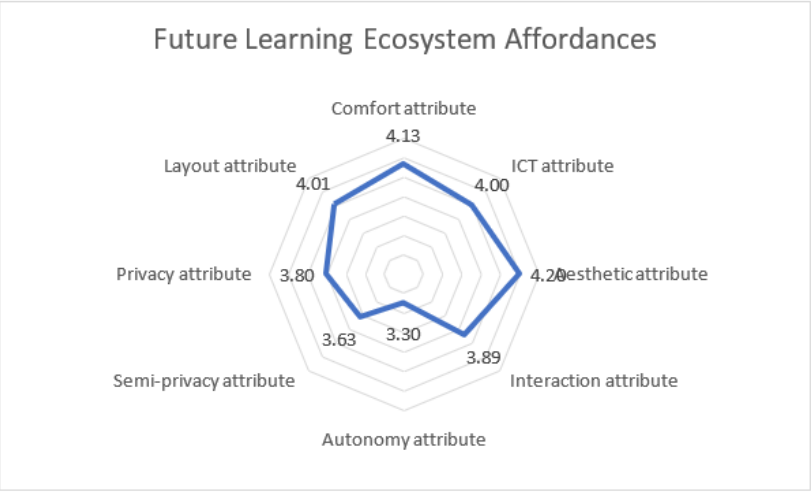

Figure 1: Future Learning Ecosystem Affordance

Study shows that aesthetic affordance attained the greatest mean score. Thus, students revealed that would prefer to perceive an appealing space design. Meanwhile, comfort affordances obtained the 2nd highest mean score. Students felt comfortable and relaxed with small corners that sell food and beverage. They don't have to leave their space in order to buy food at the café. The 3rd listed future design affordances are the layout. Students have a preference to have a learning layout to perform collaborative and self-regulated learning. A suitable layout with flexible furniture aid students with alongside study with colleagues. The 4th ranked affordances is the ICT facilities. A strong wireless internet connection helps students to execute learning anywhere, anytime on campus ground. No doubt, ICT facilities drives a vital role in achieving learning objectives in era Education 4.0. The interaction affordances obtained the 5th rank in the design attributes list. This study found that an ideal learning space must be activated and cultivate group learning, gathering with peers, meetings and multi activities. The 6th and 7th ranked design affordances are privacy and semi-privacy. These two affordances are correlated. These affordances require to be studied throughout the preliminary designing stages grounded by local learning context. Lastly, the lowest ranked is autonomy design affordances. Students prefer to have their homely learning atmosphere, whereby, they can control the ambient. Autonomy implies personal control in determining what to do,where, and when. Thus, as mentioned by Maheran et al., (2018) the reliable learning space design motivates the students' performance and enhances learningoutcomes.

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