

# A REVIEW ON THE TREND OF PHYSICAL LEARNING ENVIRONMENTS AND RECOMMENDATIONS FOR FUTURE DESIGN APPROACH

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## ABSTRACT

*For the past three decades, there is an abundance of studies that justified the impact of physical learning space on the student's learning experience focusing on independent design theories of lighting, acoustic and ventilation among many others. On top of that, a well-designed learning space is also characterised with the vital role to enhance the teaching and learning experience. This paper aims to present a synthesis of over 20 studies from 1990-2021 that focused on the relationship between the physical learning space and users' experience. The aspects taken are the said criteria of a well-designed learning environment as well as the recommendation for future consideration in designing a learning space. In summary, a physical learning space is not limited to technical and aesthetics nor short-term pedagogical function, but should consider its impact on the expected student outcomes in-line with the evolving trends of education in general. Apart from that, it is also mentioned with an immense importance to include various stakeholders, especially the users in designing effective future learning spaces due to the excessive cost that may incur.*

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**Keywords:** *Learning environment, Learning spaces, Physical school design, Teaching and learning.*



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## **INTRODUCTION**

There is an abundance of studies that justified the impact of physical learning environment focusing on independent design theories of lighting, acoustic and ventilation among many others. Green and Turrel (2005) and Barret et al. (2016) have shown that although it is hard to measure direct impact of the physical learning environment, many schools see the return of their investment through students' motivation and behaviour as well as that of the teachers'.

When it comes to understanding design of learning spaces, architecture and design theories should not stand on their own without being linked to pedagogical theories and vice versa. Martinez-Maldono et al. (2020) affirms that human-centered design approaches give an active voice to teachers, learners, and other stakeholders in shaping their learning spaces. Imms et al. (2017) also relates the classroom space with pedagogical changes. Similarly, Anglican Church Grammar School's expressed their wish to see a positive impact of future building programmes and their investment in new technologies on their students' learning. With the rapidly growing discussions on the evolution of education purpose, it is vital for the design and construction industry to keep up with the constant changes. The same also applies to government agencies, consultants and policy makers to respectfully exchange insights with the teachers and students on implementing quality yet feasible physical school environments.

This paper presents a synthesis of over 20 studies ranging from 1990 to 2021 on the physical learning environments. The aim is to understand the trend of the relationship presented between the physical learning environments and the teachers as well as students' experience. This paper also investigates the recommendation across the three decades for future design approach of learning environments.

## **METHODOLOGY**

Literature was selected based on a multidisciplinary approach in teaching and learning, educational reform, educational psychology, environmental psychology, interior design and architecture as well as school architecture.

The following keywords were used to conduct computerised searches: learning environment, learning spaces, physical school design, teaching and learning, and learning behaviour.

Literature was drawn primarily from indexed articles published between 2010 and 2021. However, it is noticeable that the access to the full articles for studies between 1990-2000 is more difficult to obtain. This has been a limitation in gathering dated studies relevant to the review. Nonetheless, with the spread of COVID-19 causing physical schools to close, there is a growing number of recent articles published on the subject of the physical learning environment. The discussion on learning spaces is also surfacing on George Lucas Educational Foundation's Edutopia, a credible and practical source for educators. More recent research papers published under the Australia's Learning Environment Applied Research Network (LEARN) are also purposely selected in conducting the review. The literature was done focusing on the perceived criteria of a well-designed learning space and recommendations for future design approach.

## **RESULTS AND DISCUSSION**

Previous studies on physical learning spaces were taken in two main settings: schools (Sallis et al., 1997; Colbert, 1997; Bovey et al., 2003; Imms et al., 2017; Ali, 2017; Norazman et al., 2019; Beyer, 2020.), as well as colleges and universities (Clabaugh et al., 2004; Ditto, 2006; Graetz, 2006; Augeri et al., 2017; Amir et al., 2021.). Although the criteria of a well-designed learning environment changes over time and context, one consistent discussion throughout the studies is on the complexity of the subject, hence highly recommending the involvement of multiple parties especially users in the design process. Table 1 summarises the overview of trend of previous studies on physical learning spaces.

**Table 1. Trend of Previous Studies on Physical Learning Spaces**

Years	Setting of Learning Spaces	Criteria of a well-designed learning space	Authors	Research concerns and future recommendation
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1990-2000	Schools	Visually aesthetic, Functions effectively Availability of toilets, Drinking water, Shade, Investment in computers  Technical	Sallis et al. (1997), Colbert (1997), Butterfield (1999)	Studies touch on basic functions and incorporating technologies  Studies also call for integrated solutions by consulting stakeholders
2001-2010	Colleges, schools	Pathways, Communal spaces, Comfortable, Less distraction, Close proximity, Plasma screens, Furnitures for discussion	Bovey et al. (2003), Clabaugh et al. (2004), Graetz (2006), Dittoe (2006),	Studies stress on understanding the students and their development especially on social interaction.  Studies also mentioned careful planning as well as training on teaching strategies involving technology to prepare students for a technology-rich future.
2011-2021	Universities, colleges, schools	Wifi connectivity, Online or distance learning, Adaptive space, Affordances of new digital technologies Holistic, Flexibility and openness, Character, Quality	Ramli et al. (2013), El Kiki et al. (2015), Sofian et al. (2015), Volkman et al. (2015), Augeri et al. (2017), Imms et al. (2017), Rands et al. (2017), Ali (2017), Bordas Eddy (2017), Norazman et al. (2019), Martinez-Maldonado (2020), Beyer (2020), Amir et al. (2021), Singh et al. (2021), Young et al. (2021)	Studies on physical learning spaces are a lot more complex. Technical aspects of the infrastructure such as brightness, seating, and interior layout are still discussed but incorporated with other issues such as comfort, pedagogical considerations, learning behaviours such as students' needs and emotion, and global issues such as effects of a pandemic.  Studies also urge for researchers to continue exploring the ever-changing possibilities of teaching and learning in the modern world and designers to understand and engage their users in the design process, while touching on socio-dynamic and inequity for the cost and implementation.

Source: Author

Overall, as shown in Table 1, a vivid trend is seen in how the discussion has shifted from lower levels of education such as schools in 1990s to higher levels such as colleges and universities in 2000s up until 2021. This shows that there is a positive growth where research on physical learning environment is deemed significant regardless of the level of education. In the early 90s, studies are focused on the technical aspects and practical functions of a learning space apart from their aesthetics to support children's physical and developmental growth (Sallis et al., 1997; Colbert, 1997). As

we approach the new millennium, these studies also touch on integrating technologies into the classrooms. For example, Caples (1996) in Colbert (1997) urges frequent consultation between teachers and architects or builders to align the school philosophy, goals, and operations with the physical design. In contrast, the studies from 2000-2010 are focused on social skills such as collaboration and technological comfort in the modern setting. For instance, Graetz (2006) believes that more additional studies need to be done to address the collision between modern devices and traditional teaching methods. This in turn will not only promote more designs of collaborative spaces for students but also lead to exploration of teaching methods to encourage collaboration in the spaces.

While Sofian et al. (2015) still discusses thermal comfort as a satisfactory factor for students in Malaysian schools, the more recent discussions on physical learning spaces also shows a trend to move towards sustainable cost and effective implementation as physical redesigning can be costly (Rands, 2017). A school design solution that proposes high-end materials and state-of-the-art technology integration into the school buildings may have caused these ideas to only be adopted by schools with the financial means. It is stated in the Universal Declaration of Human Rights that everyone has a right to quality education for the full development of their personality. Extensive studies had shown the psychological impact of a good learning space towards the teaching and learning experience, therefore designing one should not be limited to only for the privileged.

At the same time, Jackson (1999) in Chitahana (2012) warns that the huge investment in computers in schools should not go to waste. According to Jackson, it remains a very crucial first step to prepare students for the technology-rich future. Singh et al. (2021) argues that a weak digital infrastructure on top of family socio-economic backgrounds causes inequality of the learning spaces created, even more so with the rise of COVID-19 cases causing the digital divide to grow wider. Moreover, Young et al. (2021) highlighted that offering innovative learning environments without proper support in change management is not enough to bring significant changes to teaching nor learning experiences.

In short, the trend of previous studies on physical learning environment for the past three decades had moved from a straightforward observation

of the physical design to directly linking the learning space and teaching or learning, to a more in-depth discussion on education inequity and its implication on the physical learning spaces. However, it is important to note that the pattern observed may also be affected by the disconnected libraries of research on the subject, as Volkmann et al. (2015) claims that the ambiguity of the term “learning spaces” and other related terms makes it difficult to find direct searches in capturing the complexity of designing a physical learning space.

### Physical Learning Environment - Past and Present

Barnard and Sandberg (1994) map a ‘learning environment’ to consist of the elements ‘teacher’, ‘objective’, ‘learner model’, ‘fellow learners’, ‘learning material’, ‘external information sources’ and ‘tools’ while locating 'learners' at the centre of a learning environment making them as the important focus (see Figure 1).

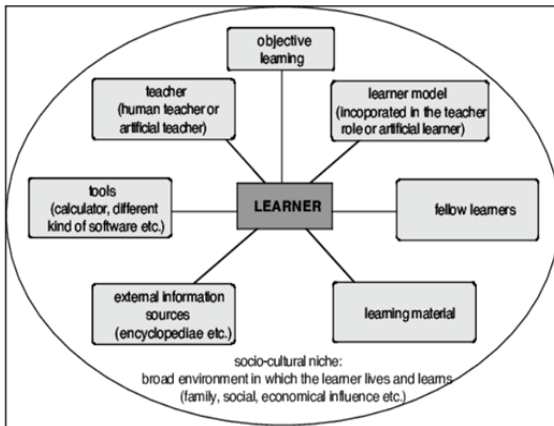


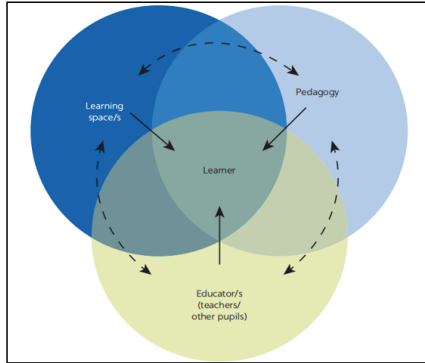
Figure 1. General Model of an Open Learning Environment

Source: Barnard and Sandberg (1994)

What seems to be missing from this earlier concept of the learning environment is the physical element of it which could arguably fall under the broader ‘socio-cultural niche’ element. This could either mean that the physical aspect of a learning environment naturally encompasses the learner and the rest of the elements or consequently, this may have resulted in the physical environment being an afterthought when planning a lesson. Nonetheless, IRIS Center of Vanderbilt University defines the term 'physical

learning environment' as the overall design and layout of a classroom or learning centre where the educators should organise the space, furnishing and materials to maximise the learning opportunities and the engagement of every child by applying the concept of Universal Design for Learning, taking into account inclusivity and accessibility. An interesting trend revolving the discussion of learning environments can also be seen where in the early 2000s, authors call for adaptations to the physical spaces in fostering positive social interaction between students (Bovey et al., 2003) and integrating human factors with technological system (Clabaugh et al., 2004). In 2006, Graetz concisely mentioned that all learning takes place in a physical environment with quantifiable and perceptible physical characteristics where students are awash in environmental information. This is in line with the purpose of 'learning environment' as to support and enhance the physical aspects of human understanding (Kopec, 2006, as cited in Ali, 2017).

Following that, the Glossary of Education Reform (2013) refers 'learning environment' to the social and emotional dimension of a school or a classroom apart from referring to the ethos and characteristics of a school or a class as well as the diverse physical location, contexts and cultures in which students learn. Ramli et al. (2013) believes that understanding what is preferred and perceived by the users in terms of their 'learning environment' is useful not only to provide better learning experience, but also to boost the awareness about the importance of the classroom physical design. Echoing the Reggio Emilia approach that coins the learning environment as the third teacher, Barret et al. (2015) maps "learning space/s" as one of the three main domains in a learning interaction as shown in Figure 2. Undoubtedly, growing changes in student expectations and attitudes also challenged institutions to reconsider the design of their learning environment (Rands et al., 2017).



**Figure 2. “Learning Space/s” as one of the Three Domains of Learning Interactions**

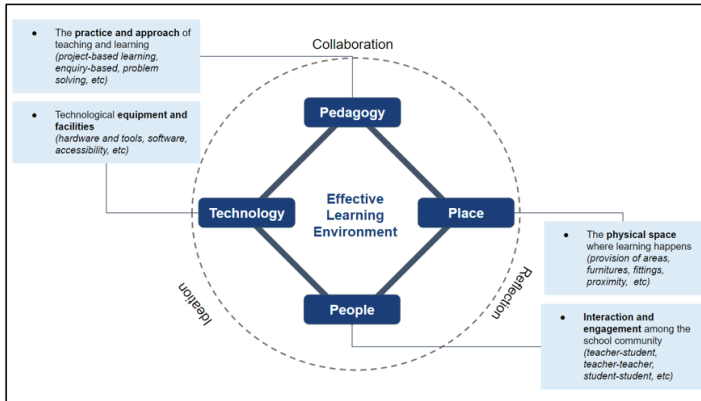
Source: Barret et al. (2015)

Although 43 percent of educational experts surveyed by the World Innovation Summit for Education (WISE) in 2014 for a report, “Future of Learning: The Classroom of 2030” believed that education will be primarily conducted online, in the same report, Mahaffie, an education futurist, envisions schools in the future as a space that maintains the physical space as a gathering place for students to interact, build and create something together. Graetz (2006) has also foreseen how it is a challenge to be taken by designers to encourage collaboration through the design of the physical environments. In other words, in previous studies, the term “learning environment” may not include the physical space but later studies then have been using the term “learning environment” to also refer to the physical spaces where learning interactions happen.

### **Criteria of a Well-designed Learning Environment**

Similar to the growing trend in terms of its broadening focus at different levels of education and the more encompassing definition for the term “learning environment”, there is a positive trend in the perceived criteria of a well-designed learning spaces too where it extends from a direct technical design elements in a learning space to a more complex elements that are relevant to the learning spaces. Figure 3 shows the redesigning framework of an effective learning environment where the different criteria are grouped into four different aspects - place, people, pedagogy and technology.





**Figure 3. The Four Aspects that Makes up an Effective Learning Environment**

Source: Edvolution (2022)

Based on the diagram, the focused aspects are then mapped to the perceived criteria of a well-designed learning space for each decade range as shown in Table 2.

**Table 2. Mapping the Focused Aspects of an Effective Learning Environment to the Perceived Criteria of a Well-designed Space Throughout the Three Decades**

Years	Criteria of a well-designed learning space	Focused aspects of an effective learning environment
1990- 2000	<ul style="list-style-type: none"> <li>-Visually aesthetic</li> <li>-Functions effectively</li> <li>-Availability of toilets</li> <li>-Drinking water</li> <li>-Shade</li> <li>-Investment in computers</li> </ul>	<ul style="list-style-type: none"> <li>-Focus is on the 'People' within the 'Place'</li> <li>-The technical aspects of the space and its functionality for the users</li> </ul>
2001- 2010	<ul style="list-style-type: none"> <li>-Pathways</li> <li>-Communal spaces</li> <li>-Comfortable</li> <li>-Less distraction</li> <li>-Close proximity</li> <li>-Plasma screens</li> <li>-Furnitures for discussion</li> </ul>	<ul style="list-style-type: none"> <li>-Focus is on the 'People' and 'Pedagogy' within the 'Place'</li> <li>-The design elements in a learning space to enhance collaboration and comfort among the users</li> </ul>
2011- 2021	<ul style="list-style-type: none"> <li>-Wifi connectivity</li> <li>-Online or distance learning</li> <li>-Adaptive space</li> <li>-Affordances of new digital technologies</li> <li>-Holistic</li> <li>-Flexibility and openness</li> <li>-Character</li> <li>-Quality</li> </ul>	<ul style="list-style-type: none"> <li>-Focus is on 'People', 'Pedagogy' and 'Technology' within the 'Place'</li> <li>-User choice and user empowerment or student agency in the digital era</li> </ul>

Source: Author

In the 90s, a well-designed learning space is one that has high technical functionality for the users. This shows that within 1990 to 2000, the focus has been on the ‘people’ within the ‘place’. A group of parents may deem a safe play space with toilets, drinking water, lighting, and shade as a good learning space for their children (Sallis et al., 1997). In the 10 succeeding years from 2001-2010, we can see the additional focus on “pedagogy” as to what makes a learning space well-designed. Bovey et al. (2003) and Graetz (2006) agree on the idea that arranging the physical environment can encourage collaboration among students. For instance, students get to learn how to be socially competent through spaces that is purposely designed to allow peer-to-peer interaction and teachers will also get to apply team teaching and interdisciplinary themes.

Within 2011-2021, the discussions on learning space designs become more complex as it includes considering ‘technology’ on top of ‘people’ and ‘pedagogy’ as well as ‘place’ to recognise a certain learning space to be well-designed. Ramli et al. (2013), Ali (2017), Norazman et al. (2019), Beyer (2020) touch on the technical aspects such as classroom colours, brightness, seating arrangement or furniture setting and acoustic, and many others mentioned about the integration of technology for a rich learning experience. It is also interesting to find that in more than 20 years ago, DeJong when interviewed by Design Share (Butterfield, 1999), already envisioned a learning space where every student should have their own laptops or mobile devices, which rings true to the ‘Bring Your Own Device’ or BYOD-compliance as stated in Augeri et al. (2017), and is a common practice in schools in the modern day. Hence, it is said that a good design of learning spaces should consider power sockets and internet accessibility that students can utilise anytime and anywhere.

In addition to that, Choi et al. (2015) suggests that extensive research on the impact of physical design on student learning should not be limited to only studying the effects of noise, temperature, lighting, wall colours and ceiling height. Flexibility and adaptability of spaces were also mentioned as it allows students to move about the classroom freely and as necessary (Bordas Eddy, 2017; Rands et al., 2017; Imms et al., 2017; Beyer, 2020). This is also supported by Brooks (2016) who compares the effects of traditional seating and technologically enhanced classrooms where he finds that different classroom types are greatly linked to the observed learning

behaviours. Norazman et al. (2019) also observed the impact of five different seating arrangements in classrooms namely traditional or row seating, clustered, U-shaped, stadium and runaway on students' social interaction and participation in class. Ali (2017) through his investigation on teacher movement within classrooms finds that not only the classroom environment impacts their movement, but it also influences the teachers' performance and productivity in delivering lessons.

Eventually, determining the specific checklist of criteria for a 'perfect design' of a learning environment may not be a feasible approach in this matter, especially when education inequity comes into the picture. Instead, we should see the principles behind these criteria to guide us in school designing where learners of the future need to first be understood in order to provide a conducive space for their learning process. As Nair et al. (2020, p. 187) puts it, "Despite our best efforts, our best ideas produce highly variable results in different contexts, depending on the capabilities, preferences, and conditions under which real people try to adapt them."

### **Future Recommendation - Involve the Users in the Design Process**

Graetz (2006) iterates that it is important to understand what enchants our students. This also applies to the physical setting where the lessons take place, other than the learning materials. Boys et al. (2014) stresses that learning space is not to be perceived on the surface level as a fixed entity prior to the building of it, rather it is a cross-interaction of users with the physical and technological aspects of the spaces. This cross-interaction also calls for continuous post-occupancy evaluation especially between users within the spaces for a continuous improvement of physical learning spaces. Conversely, Merrill (2018) thought that the scarcity of research on flexible learning spaces as compared to isolated research on physical elements such as lighting and acoustics is due to the complex nature of lived-in classrooms.

Another factor that may hinder the initiatives for the school community to redesign their own learning spaces is the fear of their effort will go to waste. US National Centre for Education Statistics in 2013 stated 40% of teachers in public schools reported facing disruptive behaviours such as vandalism and damaging school property as cited by Norzaman et al.

(2019). Despite that, Clabaugh et al. (2004) have cautioned that the right attitude must be fostered as the design and maintenance of a classroom is the responsibility of everyone. In fact, from the literature it is proven that the physical space can foster positive behaviours, therefore waiting for students to first be well-mannered before deciding to invest in transforming the physical spaces is simply idealistic.

Moreover, based on the 2021 Budget presented by the Malaysian Minister of Finance, RM725 million will be allocated to repair 50 dilapidated schools, as compared to a total of over 10,000 public schools in Malaysia. This shows that discussions on transforming the design of learning spaces in Malaysia is limited to overhaul works and it is not yet generally accepted that the federal budget should be reallocated to intentionally redesign and improve existing public schools to match the relentless pedagogical changes. Rands et al. (2017) emphasises concurrent training on classroom technology and active learning strategies among educators for future redesigns, apart from careful consideration by planners due to the high cost of physical redesign works. Nevertheless, there are many proactive initiatives taken by teachers and students to compensate for the lack of conducive environment in schools, which can be seen with the highest 22% of application for #CikguKickstart - a funding opportunity by Edufication in April 2021 - proposed for initiatives related to the physical space to be supported, followed by 16% on infrastructure and technology.

In addition to that, Ramli et al. (2013) mentioned that architects and interior designers are usually not teacher-practitioners which often leads to reproduction of 19th century industrial models of classrooms as opposed to the evolving nature of the education. Vice versa in 1997, Colbert et al. suggested that educationalists should work with a builder or architect, echoing Caples (1996) that advises teachers to regularly consult with the architect during the design process. Temple (2007), Higgins et al. (2005); and Fisher (2002) in Ramli et al. (2013) agreed that a participatory research approach would benefit teacher practices and students' learning experience. Ali (2017) also calls to bridge an experienced and qualified group of educators, interior designers, and architects to provide an effective learning environment. Therefore, participatory research among educationalists and designers would indeed allow teachers to express their vision and needs to designers who would be able to provide the desired physical environment

thus bringing advantages to the students in the long run.

On top of that, Patel and Tutt (2018) said that there are insufficient studies that examine how that designed adaptability is utilised post-construction and occupancy. Moreover, Barret et al. (2019) in the World Bank Group Report outlined the need for future research to generate evidence from projects involving infrastructures that is already implemented in various contexts such as that in countries where students' backgrounds range from low to upper middle-income apart from varying geographical location as well as cultural backgrounds. As tabulated by Barret, UNESCO Institute for Statistics 2012 also noted that while the “learning environment research” field are rapidly developing, its conclusion are often difficult to apply beyond the developed countries. In the future, the discussion on physical learning spaces should not just start nor stop at ideal design proposals of learning spaces applicable only for those who are more privileged. Rather, the stakeholders' voices must be heard by including them in the design process to ensure a feasible and sustainable design approach of learning spaces especially in the developing countries with significantly less resources to invest in.

## **LIMITATIONS**

This review paper is subject to several limitations. The primary limitation was as mentioned by Volkmann et al. (2015) on the ambiguity of the term “learning spaces” and other related terms, particularly “learning environments” which was also used interchangeably in this review paper. This may have caused the difficulty in finding direct searches where some studies might use the term “classrooms” or “school design” instead. At the same time, the terms “learning environments” may be more commonly referred to the socio-emotional setting of teaching and learning while “learning spaces” may often be simply equated to a typical 4-wall classroom.

Secondly, this review although spanned across three decades, may not entirely capture the rapid changes in both education and design aspects of a physical learning environment. We highly encourage more cross-disciplinary discussions on this research area especially in the Malaysian context for increased awareness in the future. Through this review, we

have identified Association for Learning Environment, Education Estates, Learning Environments-Design Research Laboratory (LE-DR Lab), Design Research for Modern Learning Spaces, and Learning Environments Applied Research Network (LEaRN) as some examples identified to be an actively growing effort in this interdisciplinary research between education and the built environment in global context.

## **CONCLUSION**

Ditoe (2006) acknowledges that the design of physical learning spaces will struggle to keep up with the evolution of how students learn and similarly, how teachers teach. The complexity of educational space design may change what is said to be the criteria of a well-designed learning space. It ranges from technical variables such as thermal control, lighting and colours as well as acoustics to the socio-psychological impact a space may bring through identity definition, community inclusion, or technological integration. Ultimately, all these criteria shared an aim to enhance teaching and learning experience that varies over time. Furthermore, the previous studies significantly applaud the action of multidisciplinary approach especially one that involves the stakeholders - users and planners - as a consistent step to design an effective physical learning space in the future.

The changing nature of teaching and learning in the Education 4.0 era and the restricted governance of public-school building designs especially in Malaysia should be seen as an opportunity for an engaged scholarship between various internal and external stakeholders to bring change in the physical environment of educational institutions. DeJong in Butterfield (1999) had already foreseen the need to have a dialogue about how education is going to be delivered in the future as a lot of people are not taking the time to think about school designs and construction thoroughly. With the ever-changing trends in education, it is important for people of multiple disciplines to come together and to be visionary in providing a well-thought design of physical learning spaces now and in the future.

## **ACKNOWLEDGEMENT**

We would like to acknowledge Edvolution Enterprise for their insight in education transformation work which focuses on the specific needs of each school rather than a one-size fits all. This review paper is not intended to propose a perfect school design proposal rather we hope that this article will encourage more exploration on the topic and more multidisciplinary approach - particularly between education and the built environment - in redesigning physical learning environments especially in Malaysia.

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## **CONFLICT OF INTEREST**

The authors declare no conflict of interest.

## **AUTHOR CONTRIBUTIONS**

Both authors have contributed in the review paper. Both authors have read and reviewed the manuscript.

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Tarikh : 20 Januari 2023

Prof. Madya Dr. Nur Hisham Ibrahim  
Rektor  
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Cawangan Perak



Tuan,

**PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)**

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

“BERKHIDMAT UNTUK NEGARA”

Saya yang menjalankan amanah,

*Setuju.*

*27.1.2023*

**SITI BASRIYAH SHAIK BAHARUDIN**  
Timbalan Ketua Pustakawan

PROF. MADYA DR. NUR HISHAM IBRAHIM  
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