Design Thinking and Learning Material Utilisation Creativity in Early Childhood Teacher Education: A Case of Kyambogo University, Uganda

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Abstract

In the recent past, we have seen a lot of innovations in children's learning materials, equipment and spaces design due to the work of famous educators like Montessori, 1912 and Froebel, 1837. This has led to the development of a new landscape of how children's learning spaces look like. Many children's learning centers have heavily invested in spaces design and space equipment but despite all these developments, teachers in Uganda have registered limited success in the utilization of these facilities to enrich children's learning experiences. This study was carried out to investigate how design thinking can be used to impact teaching spaces utilization creativity (Pacini-Ketchabaw, 2016; Hakim, 2017 & Masoumi, 2020). A Quasi-experimental with a mixed design approach was used with an embedded Pretest Post-test Design (Bhattacherjee, 2012). Quantitative and qualitative data was collected from a sample of a cohort of 64 in-service teachers studying a diploma in early childhood teacher education. Data was collected using observations, focused group interviews, and entries from the field notes. Using the Art world design thinking process, an experiment was developed to induce material utilization creativity. Alongside was a creativity observation to measure creativity indicators. This was used to measure creativity exhibited at pretest and posttest in both the control and experimental group. Data analysis used descriptive statistics for preliminary analysis and an independent group's t-test for analyzing the difference between the control and experimental group. Findings showed that there was a statistically significant difference between the control and experimental group at post-test; this was attributed to the art world design thinking process.

Keywords: Teaching Spaces Creativity, Art world Design Thinking Process, Pedagogical Creativity, Childhood Education and Early Childhood Teacher Education

INTRODUCTION

"The body does not exist separate from the space in which it is placed because there is a constant sensory experience that comes out of this interaction." (Pallasma, 2011). This assertion compounds a rich argument for a study that is exploring enriching the spaces we teach and live in. Quality spaces improve this manifestation experience (Dias, 2020). It is fundamentally important to have enriched learning spaces by constantly redefining, reimagining, and remodifying these spaces (Pallasma, 2011). Principles and philosophical aspects of space design creativity are premised on how the physical spaces shape social interactions and practices (Lefe, 1991; Massey, 1994). This confirms that spaces play a fundamental role in the negotiation of the user experiences. In this, it involves user perception and manipulation of the space elements to enrich their experience. Our interaction with learning spaces should be purpose-driven and flexible so that they can accommodate our feelings at a particular time (Marca, 2021). Alam (2021) adds that space design creativity improves lighting, acoustics, and air quality which are all fundamental for a

conducive learning environment. The teacher's ability to understand and use this complex relationship greatly improves learning outcomes (Oblinger, 2006). How we utilize space can shape our identity and habits (Dias, 2020). This calls for teachers to think creatively on how to engage the spaces in such a way that strengthens its relationships with the users. Similarly, learning spaces for children require such minds that can give them a character that will enrich the learners' experiences. Spaces can be modified and qualified through the use of space elements like color, sound, light, texture, smell, shape, and so forth. In early childhood education, teachers require skills in spaces creativity. This will enable them to modify learning spaces and qualify them for engagement of the children. This can be achieved through the reconstruction of functionality through creatively using space elements and enriching materials within these spaces (Stolchita, 2011; Damasio, 2010).

Early Childhood Learning centers use space elements like walkways, play spaces, sound, shapes, lines, rooms, and so forth. These should play a vital role in shaping the learning experience of the children. There is a need to re-equip teachers with competencies in space utilization to enable them to use spaces in an integrated way (Dominoni, 2021). With the increasing focus on improving the quality of learning outcomes (SDG 4) for all children, a lot has been done in areas of pedagogy, teaching, and play materials. There is however, limited evidence on spaces utilization creativity. This raises concerns for researchers to investigate how spaces utilization creativity can be harnessed to improve the teacher learner engagement. This study sought to use the art world design thinking process as a thought process methodology to improve teacher creativity in spaces utilization. The study was anchored on the theory of transfer of learning by Thorndike and Woodworth in 1901 (Aarkrog, 2011). The theory proposes that learning in one context enhances (positive transfer) or undermines (negative transfer) a related performance in another context (Perkins & Salomon, 1992). And in a similar fold, the study thought to transfer the effect of design thinking to the use of teaching spaces.

The Art World Design Thinking Process

The Art world design process is a method or approach designers use in the product development process. This approach has been developed into several models that follow several stages according to different developers. This approach has been crafted to provide a procedural framework to develop a given product or service. In it, there is a robust and rigorous engagement of back and forth movement between the stages in the bid to refine the product. For this study, we used the five-step Stanford designer model shown in Figure 1 below;

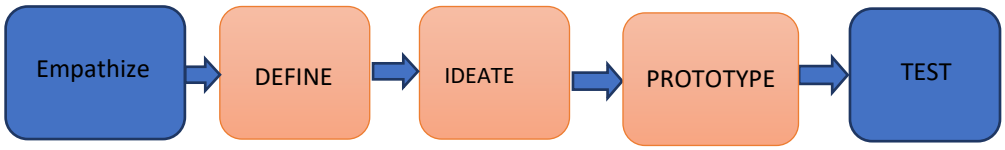

Figure 1: The Art World Design Thinking Process
Source: Adopted and Adapted from Dam &Yu Siang (2008).

This model is made up of five stages as summarized below. These are:
Empathizing is the stage that helps a designer to gain a deeper understanding of the problem from a user perspective without allowing their assumptions to block their appreciation of the individuals at the heart of a given situation (Baeck & Gremett, 2012). It is research into the challenges, advantages, assets, threats, and opportunities from the point of view of the user. Defining is the second stage in the process, where by a designer compiles all the information collected in the first stage and makes meaning of it before coming up with a concrete issue that the people they interacted with may have been trying to drive at

(Nairman, 2019). At this stage, the designer develops a point of view on the specific challenge to address or the opportunity to take. Ideate is the third stage in the design thinking process. In this stage, the designer uses the conclusions arrived at in the defining stage to get tentative solutions to the problem. Thinking big and wide is critical to help build up ideas (Baeck & Gremett, 2012). Thus, thinking here will not necessarily follow the usual patterns as a lot of thinking outside the box is encouraged. The fourth stage is the prototype stage. In this stage, the different solutions are tried or experimented to see how best they answer the identified problem (Waloszek, 2012). It has a lot of building and breaking to find what fits as desired. The last stage is the test. It is a stage that allows the designer to try out the best option developed to solve the problem in different contexts that may be available (Waloszek, 2012). During the test, further modifications can be made to make things better.

Preparing the teacher to use the Art World Design Thinking Process

The success of this innovation was highly dependent on the teachers' preparation to get their minds oriented with how designers think and work using the different design thinking stages (De Putter-Smits et al., 2013). He emphasizes understanding context, regulating the learning process, and rethinking learning environments and materials. To allay the fears surrounding the teacher skills, an experiment was developed using the five stages of the art world design thinking process. Using the adapted version, we implemented an experiment with a group of teacher trainees to equip them with skills in spaces utilization creativity. Below in Table 1 is the experiment schedule.

Table1: Experiment Schedule for Teaching Spaces Utilization Process

	EXPERIMENT STEPS	DESIGN PROCESS	TEACHER PROCESS	THOUGHT PROCESS QUESTIONS
1	Empathizing	- Set aside assumptions and share experiences with persons involved to get the human side of the challenge. -Develop the best possible understanding of the users, their needs, and the problems that underlie the development of that particular product. -Conduct research on user and competitor products	- Learner spaces needs assessment	-What are their spaces needs -What spaces elements motivate them -What are their spaces experiences
2	Define	-Study the expected Competences - Definition Concepts -Make Connections on meanings using other fields. -Reframe the Problem -State the problem -Ideas to establish features, functions, and any other elements required -Select ideas that have a large impact	- Identification of Specific Problems related to available spaces - Definition / Reframing of these problems/spaces	-Do I understand the situation? -How might we …? -Is the approach iterative in nature - for spaces
3	Ideate	-Think out of the box and brainstorm / Suggest ideas even strange ones. -Challenge commonly held beliefs -At this point, it's about a broader range of ideas, not the best idea	- Suggesting a variety of possible solutions to the problems of the space	-What other alternative ways can the problem be viewed -Am I exercising free thought -Are we bold and Curious? -Are we drawing our focus on fresh Perspectives? -Iteration - for spaces
4	Prototype	-Evaluate/ Discuss the available options of ideas -Put to real-life / Visual versions of ideas -Bring stages 1,2 and 3 ideas in	- Put the suggested spaces ideas to life. - Identify their features/elements and how they manifest themselves	-What are the elements needed? -What are their features? -What can/do these features mean? -What is the best possible solution? - for spaces
4	Test	-Share and test the prototypes -Interface solutions with real people -Iterative approach to testing / trying out	Test them in a teaching context/setting or real educational context	-What solutions are working -What's not working? - How better can we present successful solutions? -Is Fidelity in the check? - for spaces

Source: Adopted and Adapted from Dam & Yu Siang (2008)

MATERIALS AND METHODOLOGY

Research Design

The researcher used a concurrent embedded mixed methods design within which both quantitative and qualitative data were collected. Data were collected concurrently, analysed separately, and embedded at the discussion phase in which qualitative data was used to strengthen the statistical results (Morgan, 2007; Creswell, 2014; Kumar, 2011). This design

was suitable for a research experiment in social science that sought to study a cause-effect relationship. See figure 2 below;

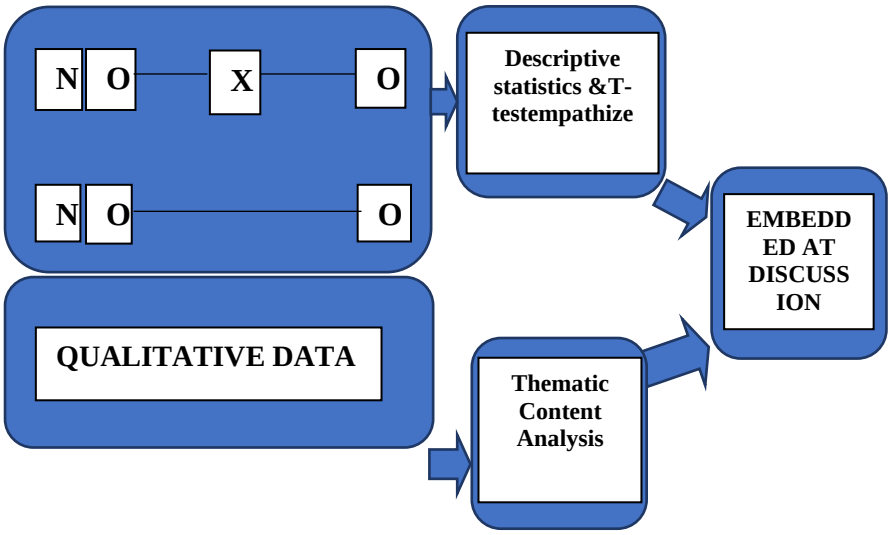

Figure 2: Concurrent Embedded Mixed Methods Design (Non-equivalent groups design model (Bhattacherjee, 2012)

Sampling and Sampling Procedure

A two stage sampling was applied, one was purposively selecting two colleges that had the sample of the Diploma in ECD in-service students and two was by cluster sampling where two selected colleges formed two clusters because the design required the use of the control and experimental group. The total sample was 64 in-service trainees doing a diploma in early childhood education.

Measurement

Measurement of the difference between the pretest and posttest data was based on an experiment that was adapted from the art world design thinking process. A creativity indicator tool was used to observe the two groups before and after the treatment. All items were developed to measure creativity tendencies in spaces utilization. They were scored on a scale of 1-5 on which scoring 1-2 was considered "Basic", 3 was considered "Intermediate", 4 was "Proficient" and 5 was considered "Advanced". To ensure reliability and validity, a pilot test was done to scrutinize and polish the instruments to a CVI = .78, while a test-retest reliability on the Cronbach scale was .82 making the tool reliable.

Data Analysis

Preliminary data were analyzed using descriptive statistics and to establish if there existed a significant mean difference between the control and experimental t-test for independent groups was done using SPSS. The qualitative data obtained were analyzed using the thematic content analysis approach.

RESULTS AND DISCUSSION

To measure the statistical difference between the control and experimental group, a 25 item creativity indicator observation tool was developed and subjected to participants in both groups before and after the treatment. The resultant data is analyzed below;

Comparison of Control and Experiment Group Pre-Test Data for Teacher Spaces Utilization Creativity

To be able to compare the data and determine if there was a difference between the control and experimental group in teacher spaces utilization creativity, the team collected pretest data from the control and experimental group. The data was analyzed and presented on a statistical figure 3 below.

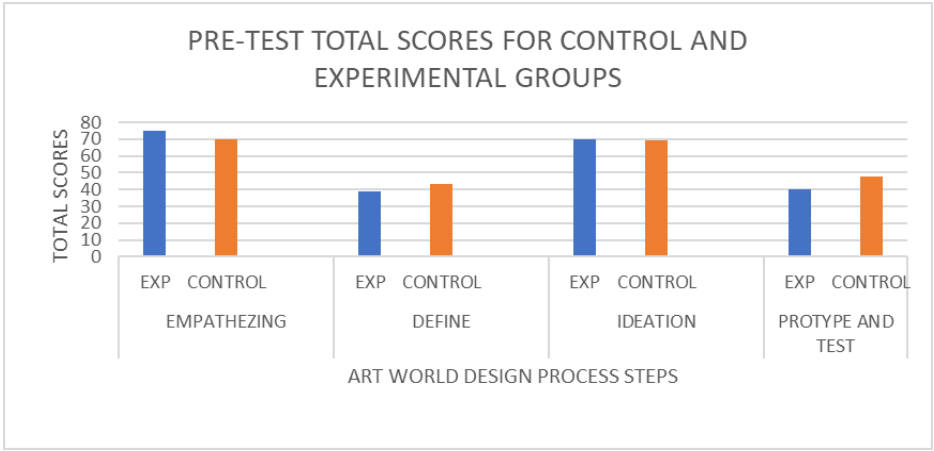

Figure 3: Comparison of Control and Experiment groups at pre-test level
Source: Primary Data 2020

The statistical figure 3 above compares the control and experimental group at pretest. The results showed that in empathizing and ideation, the experimental group was slightly better than the control group with a margin of 5 and 1 respectively. The control group was found to be better in defining, prototype, and testing, with a margin of 4 and 8 respectively. These differences were insignificant and this implied there was no statistically significant difference in the two groups allowing for their comparison. See table 2 below;

Table 2: Mean table comparing control and experiment groups at pre-test level

Paired Samples Statistics		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Control group Pretest	7.7667	30	1.13512	.20724
	Experimentalgroup Pretst	7.4333	30	1.00630	.18372

Source: Primary Data 2020

From Table 2 above, the control group has got a slightly higher mean of 7.76 as compared to 7.4 for the experimental group. It also has a higher SD=1.1, as compared to the experimental group which has SD=1.0. However, the mean difference of 0.36 can be considered negligible, and therefore, this analysis showed that at pretest there was no statistical difference between the control and experiment groups. This was further compared on a t-test in Table 3 below.

Table 3: T-test difference between Control and Experiment groups at pre-test.

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Control Group Pretest Experimental Group Pretst	.33333	1.76817	.32282	-.32691	.99358	1.033	29	.310

Source: Primary Data 2020

Table 3 above shows that at pretest, the t= 1.0; p=.310; df =29, the p-value is much higher than the critical value of 0.05 which meant that there was no significant difference between the control and experimental group at pretest.

Comparison of Control and Experiment Group Post-Test Data For Teacher Spaces Utilization Creativity

After the pretest observation, the experiment was introduced to the experimental group whereas the control group was allowed to continue with the routine training program. After the experimental process, a posttest observation was done on both the control and experimental group to establish whether there was a statistically significant difference between the two groups in teacher spaces utilization creativity and after analyzing the data, the results were presented in a statistical figure 4 below.

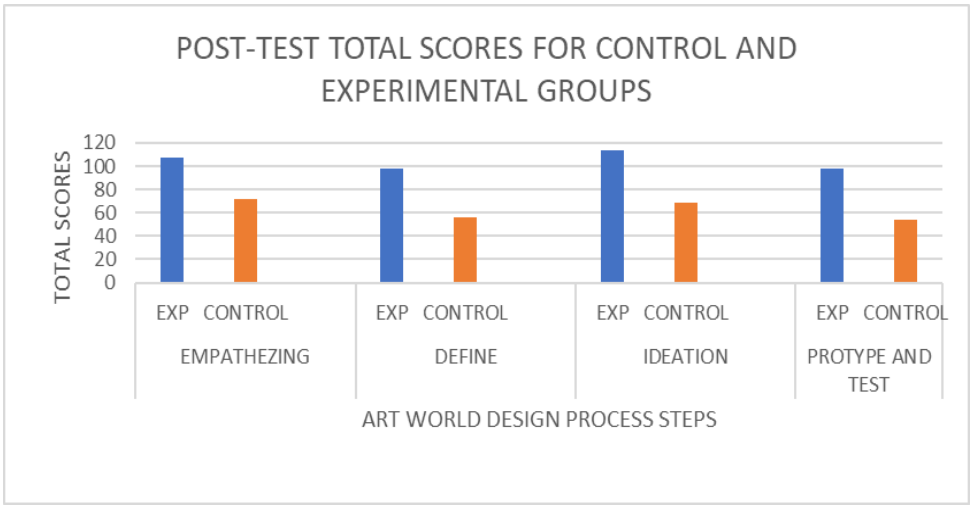

Figure 4: Comparison of Control and Experiment groups at the post-test level
Source: Primary Data 2020

Figure 4 above shows that experimental group had a higher total score in all the four areas that were measured. The difference is quite significant which explains the hypothesis that there was a statistically significant difference between the control and experimental group at posttest. To affirm this, data was further analyzed as shown in table 4 below.

Table 4: Mean table comparing control and experiment groups at the post-test level

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Control group pretest	8.3667	30	1.42595	.26034
	Experimental group pretest	13.9000	30	1.29588	.23659

Source: Primary Data 2020

Table 4 above, shows that at posttest the experiment group had a higher mean score of 13.9; with SD=1.41, as compared to the control group which had 8.36; and an SD=1.29. Comparing the mean difference of 0.36, at pretest, and 5.54 at post-test, shows a significant difference. The groups were further compared on t-test as shown in Table 5 below.

Table 1.5: T-test difference between Control and Experiment groups at post-test.

Paired Samples Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	T	df	Sig. (2-tailed)
Pair 1	CONTROLGROUPPRETEST - EXPERIMENTALGROUPPRETST	-5.53333	2.02967	.37056	-6.29122	-4.77544	-14.932	29	.000

Source: Primary Data 2020

Table 5 above shows that at posttest t=-14.9; with a p=.00; and a df=29. With a p-value that is much lower than the critical value of 0.05, It gives a statistical explanation of significant difference between experiment and control groups at posttest in teacher spaces utilization creativity. In this study, we examined the contribution of the art world design thinking process on the spaces utilization creativity of teachers in early childhood education. The overall results showed that there was a statistically significant difference between the control and the experimental group at post-test which eludes to the fact that the art world design thinking process can potentially improve teacher creativity in spaces utilization. The study found out that;

Spaces Flexibility

Pretest observations revealed that in both the control and experimental group, the spaces were not flexible. We observed that children were sited on chairs facing the teacher in the classrooms in a traditional classroom setup. This meant that even though the chairs and desks were movable, the teacher's perception of that space was static. We also observed that even other elements like the teacher had a particular place that is standing in front of the children. There was little or no intentional flexibility in the use of the spaces yet for a learning space to be of good flexibility is a key element. Avoiding standardization offers opportunities for adaptation of the space to suit varying situations (Soiland & Hansen, 2019). However, posttest observations revealed a lot of flexibility in the classroom setup. We observed that participants were able to rethink the classroom spaces. Classroom space arrangement was guided by the planned lesson activity where teachers and learners were interacting with the spaces more meaningfully. The trial experiments on understanding user needs had yielded insights into how to customize spaces for specific activities. Children need less institutionalized learning spaces (Nilsen, 2012). There is a need for spaces that are less controlled and flexible to meet individual children's needs.

Children's Spaces Conception approval

During pretest observations, participants in both groups did not show any conscious engagement of learners in space conception approval. We observed that participants were using both indoor and outdoor spaces in prescribed ways. Irrespective of the differences in elements, they still used them in similar ways. Yet it is important that space functions are conceived and well planned to suit and improve learning activities as MOLL (2020) suggests that learning spaces are a collective venture between the teacher, space elements and the learner that aims at enhancing knowledge sharing. However, posttest observations revealed that the experimental group participants were engaging learners in spaces conception. We observed that teachers were aware of space elements and were able to

consult with the children on how best to utilize the space's elements. In this process, children contributed ideas of how to use the spaces to suit their interests. Children's conceptions of spaces were aligned with their patterns and behavior in learning and playing (Latfi & Karim, 2012).

Methodological Spaces Conception

Pretest observations revealed that participants in both the control and experimental groups were unable to deliberately plan alignment of methods with the spaces. Participants were not aware of the importance of planning for spaces in light of the planned methods. Yet a teacher must be able to conceive how a given method and its activities fit into the selected space. Nicholas (2020) suggests with what he calls 'structured imagination' that teachers must continue to craft novel concepts of how to use spaces to suit learning activities. However, at post-test, the participants in the experimental group were more deliberate on space plans fitting into the selected method and its activities.

Variety of Spaces Plans

During the pretest pre-conference session, it was evident that participants had no spaces plans as part of their planning. Spaces were used in the way they would be found. Creating physical spaces plans for children's activities helps the teacher to make prior connections between the methods, materials, and activities. We observed that good activities often failed because of a wrong choice of space. Yet we know from the literature that well-planned spaces encourage exploration, curiosity, and imagination which are fundamental blocks for learning in the early years (Atmakur, 2016). At posttest, the experimental group participants had spaces plans as part of their documentation for lesson plans. This led to sync between the spaces and planned activities. The participants and the learners were observed fitting into the plan. Prototyping phase had yielded results in the participants' ability to visualize spaces plans. Spaces plans offer an opportunity to envisage what is feasible (Yuill, 2020).

Using Spaces Elements

We observed at pretest that participants were not using spaces elements creatively. Spaces environments are comprised of different elements which the teacher can harness and use creatively to enrich the learning experiences. Irrespective of their existence, teachers simply walked into the rooms without thinking about their elements. Yet we observed that often children were playfully engaging with elements in the space where they studied. Learning spaces for children attract their attention and this engages them on both physical and psychosocial grounds (Mannav & Erkan, 2012). The post-test observations revealed that teachers were more aware of the space elements and were utilizing them.

Spaces Assessment Information

Lastly, we observed that participants were not using a variety of spaces assessment information. We observed that participants had no record of assessment information for spaces. In the post-conference discussion, they expressed not being aware of spaces assessment. Yet assessing children's spaces gives supporting adults an awareness of what kind of elements are in a given space, how they excite children and how to use them. There is a need for a teacher to do space assessment because children are continuously negotiating, re-organizing and re-constructing these spaces (Vuorisalo, Raittila & Rutanen, 2018). Posttest observations revealed that participants were having information from spaces assessment. This led to expression of awareness of space elements and workable spaces plans. Such vital information was useful in adjusting the activities and spaces for a better learning experience. Spaces assessment helps a teacher to develop insights into spaces based factors that motivate children while using given spaces (Saragih & Tedja, 2017).

CONCLUSION AND RECOMMENDATION

The study was designed to investigate the effect of the Art World Design Thinking Process on the development of Spaces Utilization Creativity. This was based on the theoretical argument enshrined in Thorndike and Woodworth's (1901) theory of identical elements in which we intended to transfer the knowledge of the design thinking process from the art world to use it in the development of teacher pedagogical creativity thinking process. An adaptation of the Art world design thinking process was created in form of an experiment. This adapted process was then used as a treatment on developing Teacher Spaces Utilization creativity. Based on the resultant quantitative and qualitative data analyzed, it can be concluded that the Art World Design Thinking Process can greatly improve Spaces Utilization creativity. The study used a pretest-posttest approach because we were interested in establishing the difference between the control and experimental group. This difference was a much-needed part of the study since it would provide evidence for the presumed effect of the transferred knowledge and skills. Based on the results of the experiment with the literature gaps in the discussion, we consider that the selected methodology was able to answer the research questions satisfactorily. This research clearly explains the effect of the Art World Design Thinking Process on Spaces Utilization creativity but also raises questions on whether the effect on teachers would result in better and enriched experiences for children and thus this study recommends further studies into using a related approach on children.

REFERENCES

Aarkrog, V. (2011). A Taxonomy for Teaching Transfer Skills in the Danish VET system. *Nordic Journal of Vocational Education and Training, 1*(1), 1-12.

Alam, M.D. (2021). Sustainable Co-working Space design.

Baeck, A., &Gremett, P. (2012). Design Thinking: Expanding UX Methods Beyond Designers. In H. Degen& X. Yuan, *UX Best Practices: How to Achieve More Impact with User Experience* (pp. 229–250). New York: Osborne.

Damásio, A. (2010). O Livro da Consciência. A Construção do CérebroConsciente. Lisboa: Círculo de Leitores

De Putter-Smits, L. G. A., Taconis, R., & Jochems, W. M. G. (2013). Mapping context-based learning environments: The construction of an instrument. 437–462.

Dominoni, A. (2021). Space Design Between Research, Project, and Education. 10.1007/978-3-030-60942-9_4.

Marca, Susan. (2021). Lost in Space: Designing for Learning. IASL Annual Conference Proceedings. 10.29173/iasl7727.

Nairman, L. *(2019). Design Thinking as a Strategy for Innovation: https://www.creativityatwork.com/design-thinking-strategy-for-innovation/of Educational Psychology*, *61*(2), 207-219.

Perkins, D. N. & Salomon, G. (1992). Transfer of learning. *International Encyclopaedia of Education, Second Edition, 2-13. https://www.researchgate.net/publication/2402396_Transfer_Of_Learning*

Rogers, C. (1970). Toward a theory of creativity. In: P. Vernon, Ed., *Creativity: Selected reading*, Harmondsworth: *Pen-guinBooks*,

Stoichita, V. (2011). O EfeitoPigmalião. Para umaAntropologiaHistórica dos Simulacros. Rio de Janeiro: Imago

Waloszek, *G. (2012). Introduction to Design Thinking, 2012: https://experience.sap.com/skillup/introduction-to-design-thinking/*

Yuill, N. (2020). Metadata of the chapter that will be visualized online Chapter Title Play Space Design in Autism 3 Definition: Play Space Design in Autism. 10.1007/978-1-4614-6435-8_102329-1.