Humanities & Social Sciences Communications

ARTICLE

https://doi.org/10.1057/s41599-024-03930-5 OPEN

Examining the use of LEGO Serious Play to enhance postgraduate research capacity

Idris Olayiwola Ganiyu [1✉], Gosia Plotka[2], Patrice Seuwou[2] & Adejoke Ige-Olaobaju[2]

The use of LEGO Serious Play as a tool to enhance postgraduate research capacity is an emerging concept that has gained attention in recent years. This hands-on, interactive approach to learning and problem-solving has been utilised in a variety of fields and industries, but its potential in the realm of postgraduate research is still being explored. One of the main challenges faced by postgraduate students is the ability to think critically and creatively in their research projects. These challenges may be connected to the traditional teaching methods in postgraduate research, such as lectures and seminars, which often focus on theoretical concepts and do not provide students with practical tools to apply these concepts in their research. This can result in students feeling disconnected from their work and lacking the skills and confidence to think outside the box. This study examined the use of LEGO Serious Play to enhance postgraduate research capacity. A quantitative research approach was adopted for data collection and analysis. A simple random sampling technique was employed to select a cross-section of postgraduate students who participated in this study for data collection. Partial least squares structural equation modelling using SmartPLS 4.0 was employed to test the mediating influences of pedagogical technique and postgraduate students' research capacity on the relationship between LEGO Serious Play and research outcome. The finding revealed that LEGO Serious Play exerts a significant positive influence on pedagogical technique. The implication for practice which emerged from the outcome of the statistical analysis is presented in this study.

[1] York Business School, York St John University, York, UK. [2] University of Northampton, Northampton, UK. ✉email: Idris_olayiwola2005@yahoo.com

Introduction

Social research is aimed at providing solutions to many of the social problems confronting humanity; that is, problems resulting from the increasing complexities of the world we live in today. These problems are so complex that solutions to them cannot be arrived at using only the conventional research lens. This justifies why educational institutions, specifically in the West, are beginning to adopt LEGO Serious Play (LSP) as a non-traditional research method to conduct research. Empirical evidence suggests that the use of LSP in higher education institutions and other settings presents a viable research option through the alignment of LSP with other approaches to enhance students' research capacity (Wengel et al., 2021; Zenk et al., 2018). A previous study conducted by Zenk et al. (2018) identified the benefit of adopting LSP in higher education institutions to include the exchange of ideas, creative thinking, representation of information, the quality of group interaction and enjoyment. However, the shortcomings of using LSP included "the reluctance of participants, obstacles to implementation, criticism of the outcome and limitations of the method" (Zenk et al., 2018, p. 246).

LSP was initially developed for businesses to enhance creative thinking and employee engagement in the boardroom with the aim of bringing about informed decisions for organisational competitiveness (Nerantzi, 2018; Wengel et al., 2021). However, LSP is adopted by higher education institutions as a non-traditional research method, particularly for postgraduate research. Postgraduate research in higher education institutions is constantly evolving to provide solutions to many real-life complex problems. In solving the real-life problems through research, new knowledge is created. In most cases, the new knowledge that is created brings about new ideas, innovation, and some of the wonders that make life worth living. Therefore, the introduction of LSP to higher education institutions is aimed at enhancing students' learning experience. This study seeks to examine the use of LSP to enhance postgraduate research capacity with a specific focus on a university in the United Kingdom (UK). While LSP fostered reflective thinking and interaction among the postgraduate students on their individual research projects, the effectiveness of the method in enhancing the research capacity is in doubt. This study examined the use of LSP to enhance postgraduate research capacity.

Literature review and hypothesis development

LSP is an innovative approach that employs Lego bricks as a tool to facilitate learning and understanding. This study examines LSP from the lens of constructivist learning theory. The link between LSP, pedagogy technique and research outcome were examined to unpack the gap in in literature.

LSP as a research construct. LSP as a research construct refers to the use of LEGO bricks as a tool in research activities. It is based on the principles of constructionism and play to promote a creative and hands-on approach to exploring complex topics and stimulate innovative thinking (Liang et al., 2021; Roos and Victor, 2018). A recent study by Nurhuda et al. (2023) suggests that to enhance students' enthusiasm for learning, educators must innovate by employing the constructivist approach to learning. Consistent with the constructivist approach, LSP aligns with the principles of learning as it engages learners in the process of constructing meaning through experience. The use of LEGO bricks as a medium for learning allows students to manipulate concrete objects, make connections, and create their own mental representations of concepts and ideas (Liang et al., 2021). This hands-on approach is essential for constructivist learning as it enables learners to interact with the material, reflect on their experiences, and construct their own understanding.

As an innovative tool, LSP is a facilitated process designed to engage students in creative problem solving and has been seen to increase student engagement, critical thinking, collaboration and communication skills (Nerantzi, 2018). LSP also encourages students to think outside of the box, to explore alternative approaches to problem solving and to develop creative solutions. The use of LEGO bricks allows students to create visual representations of their ideas and encourages them to engage in active learning. LSP has been implemented in a variety of different disciplines including engineering, business and psychology (Ajibade and Hayes, 2022; Hayes and Graham, 2020). It has also been used in teaching courses related to interdisciplinary topics such as sustainability and business analytics. In addition, LSP has been used to address student mental health issues such as anxiety and depression (Warburton et al., 2022). LSP has been used to facilitate a wide variety of learning activities such as brainstorming, problem-solving and team building. It has been found to be particularly effective in promoting student engagement as it encourages students to work together to find creative solutions. Additionally, it has been seen to improve student understanding of complex concepts and to foster collaboration and communication skills.

LSP and pedagogical technique. LSP was conceptualised as a problem-solving mechanism that leveraged hands-on activities to achieve desired outcome (Dann, 2018). In recent years, facilitators and teaching staff have introduced creative pedagogical tools such as digital games, simulations and board games in the teaching environment to enhance learners' engagement and participation (Hale Feinstein et al., 2002). Previous studies suggest that the employment of this approach has proved to be beneficial for learners, as it has enabled greater engagement than instructional teaching approaches (Dacre et al., 2015; Gkogkidis and Dacre, 2021). However, a more creative, innovative and adaptable approach may also be employed for teaching and learning in higher education. This method is LSP which has been examined for high value, and its application over time has improved students' knowledge co-creation and knowledge retention (Grienitz and Schmidt, 2012). Grienitz and Schmidt (2012) argue that facilitators and teachers can use LSP to successfully embed the values of constructivist learning theories into their teaching practices, thereby creating an exploratory learning environment that will encourage student participation. An exploratory learning environment in this context is when a learner is involved in the learning process by contributing his/her own ideas and interpretation of the knowledge under review. According to Biggs (1996), integrating the LSP process in the classroom requires a level of constructivism to fit the potential of the method to the purpose of the method. The order in which this level takes place can occur at the graduate attribute level, assessment task level or learning outcome level.

To align LSP to a pedagogical environment, it is important to be aware of the unique approaches to problem-solving that this method offers. This includes the use of visual metaphors to help present abstract concepts, the use of storytelling to scaffold complex concepts and ideas, the use of hands-on activities to facilitate a deeper understanding and the use of reflective practices to help draw connections between the physical models and the problem-solving process (Nerantzi, 2018). By emphasising the importance of LSP in the pedagogical environment, educators can create a unique and engaging learning experience. This includes incorporating play-based activities into the

curriculum, leveraging the visual nature of the models to introduce abstract concepts and using reflective practices to help students to develop their own solutions to the problems they are facing. By creating an environment that is conducive to learning, students will be better able to grasp and apply the concepts they are being taught. These, put together, become the exploratory examination of the effect of LSP and the fitness of the LSP process in the classroom environment (Dann, 2018). Based on the forgoing, we hypothesise that:

H1: LSP exerts a significant influence on pedagogical technique.

H2: LSP exerts a significant effect on postgraduate students' research capacity.

H3: LSP exerts a significant effect on postgraduate students' research outcomes.

H4: Pedagogical technique exerts a significant effect on postgraduate students' research capacity.

Use of LSP in higher education institutions. LSP has been used to teach learners in a more creative and engaging way. As a result, learners are able to visualise the concepts they learn, and this helps them to gain a deeper understanding. It has been noted to offer an effective way to teach problem-solving skills as learners are encouraged to think creatively and find solutions to challenges (Nerantzi and McCusker, 2014). It provides an environment for collaboration and helps to develop social skills. Moreover, it is a great way to encourage teamwork and foster the development of communication and leadership skills. A study conducted by Gkogkidis and Dacre (2021) uncovered the challenges faced by business schools and educators in delivering social, economic and environmentally focused subjects to their students accurately. They combined a variety of pedagogical theories, such as Duckworth's (2006) exploratory learning methodologies, Stubbs and Cocklin's (2008) organisational sustainability teaching models, and empirical findings on the implementation of LSP in educational contexts. Their concept was built around the use of LSP as a creative approach to teaching and learning, which allows students to make use of the LEGO bricks to improve their engagement and participation and that, in turn, will help in shaping accountable organisational leaders.

Generally, there is a wide range of active learning approaches that are being used in various fields of study. Some of these approaches are project-based learning (Codur et al., 2012), flipped classrooms (Kerr, 2015), simulation-based activities (Cheong et al., 2019), virtual-learning laboratory environments (Cheong and Koh, 2018), virtual reality applications (Román-Ibáñez et al., 2018), serious video games (Bodnar et al., 2016) and educational escape rooms (López-Pernas, 2019). These approaches are active, but researchers could explore a more creative and useful approach that is also applicable in industry and organisations (Lopez-Fernandez et al., 2021). The best approach that fills these gaps is the LSP which was basically modelled to boost creativity and efficiency in the business world (James, 2013). Having analysed the advantage of LSP over other approaches stated above, LSP is now being taken seriously in the higher education sector, and it is being used in several fields of study, such as art, marketing, and engineering (Hansen, 2012; James, 2013). This also extends to software engineering (SE) (Kurkovsky, 2015; Kurkovsky, 2018), as the LSP concepts have boosted students' motivation and developed various soft skills in them. To further validate the usefulness of LSP in SE, Lopez-Fernandez et al. (2021) described the potential use of one of the LSP activities in engineering education. They modelled their proposed work using an original LSP activity to explain fundamental SE concepts to students in a creative, playful, and active manner. Their model is based on SE activities and the software development lifecycle model, which also extends to other fields of engineering, so their model can also be applied to other areas. After all experiments were done, the result gave numerous insights into the impact of LSP on SE and computer science education. Some of these insights are that the students find LSP engaging, LSP helped improve students' soft skills such as leadership, teamwork and communication, and that their model LSP activity is as effective as the conventional approach on account of it helping students to gain important knowledge about SE activities and its development lifecycle models.

LSP in higher education has proposed a protocol for both the facilitators and participants to use as a guideline and gave four essential stages of assistance, which are: the educator puts forward a question, students build a LEGO model to answer the question put forward, students share the connotation of their LEGO model and the educator with the students shares thoughts on the connotation given by each student. These protocols bring about proactive brainstorming, which is crucial in problem-solving. Evidence suggests that LSP has helped learners collaborate more effectively in groups in the aspects of themes/topic creation, processes, and outputs (Dann, 2018). Therefore, the following hypotheses are proposed:

H5: Pedagogical technique exerts a significant effect on postgraduate students' research outcomes.

H6: Postgraduate students' research capacity exerts a significant effect on research outcomes.

The effect of LSP on individual and group dynamics. Fundamentally, LSP was proposed to change the conventional style of strategy-making into a leaner forward approach whereby everyone in a team participates simultaneously in constructing solutions to problems as compared to the traditional way where part of the team participates in turn. Generally, the concept of LSP activates the human brain through the use of hands in constructing LEGO bricks, which obviously helps in making better decisions (Heikkinen and Nemilentsev, 2014). So, in summary, LSP enhances participation, insights, ideas, passion and provides better results.

Since LSP is about the playing of the game, the game itself has some typical characteristics that affect individuals or groups. Brown and Vaughan (2010) suggest that a game has no predetermined goal and is voluntary, meaning that an individual cannot be obligated to participate. People are naturally drawn to games due to their interest and curiosity, which is often fuelled by the freedom of time that accompanies playing. When playing a game, a person's awareness of themselves and the environment is minimised, allowing for great improvisation opportunities. Ultimately, it is up to the participants to decide how long they would like to play and whether or not they wish to continue.

The creation of LSP has exclusively provided a space for strong collaboration in teams, whereby there are different players (i.e., participants) with their respective roles and strengths; this, therefore, allows for them to bring these strengths (i.e., each player deals with issues in his or her own pattern or capacity) and work efficiently in the work community. It can then be concluded that LSP has affected individuals and groups positively as compared to negatively, on account of helping organisations set their objectives and goals, novel innovation to the work community, development of goods and services and managing changes, to mention but a few (Heikkinen and Nemilentsev, 2014).

A study done by Wheeler, Passmore and Gold (2020) showed that people who participated in the study experiment felt the experience of engaging in LSP improved their sense of

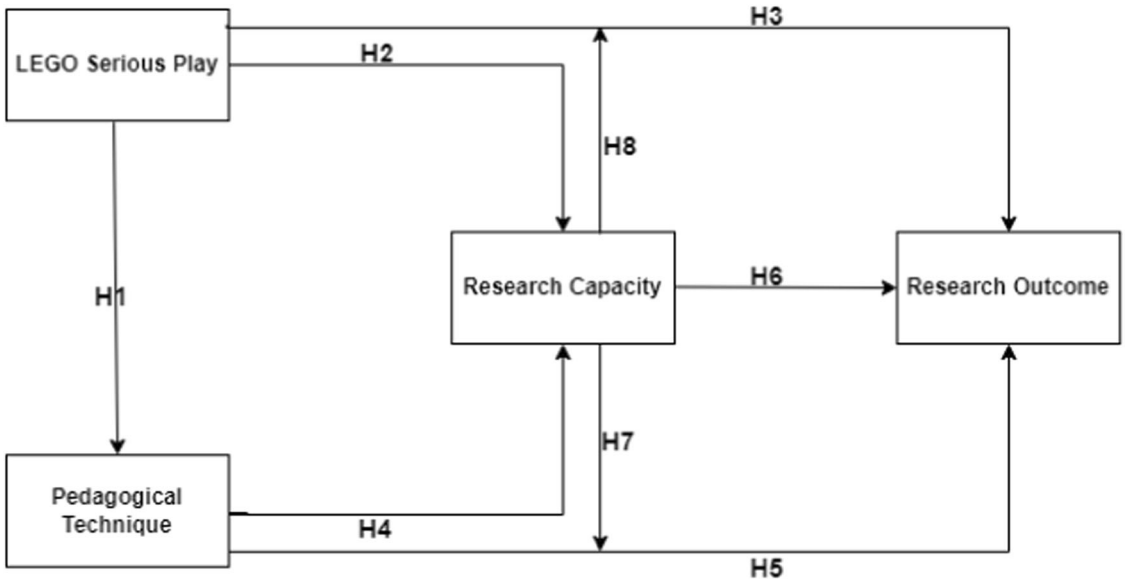

Fig. 1 Conceptual framework.

psychological safety and their manner of approaching issues collaboratively. It should be noted that when psychological safety is present in a gathering, the people belonging to a certain group feel secure in expressing themselves, which will further assist them against being rejected and give them the ability to express themselves even more (Edmondson, 1999). In another study by Heikkinen and Nemilentsev (2014) the LSP method was introduced to a training group of 25–30 people from different academic fields. The training group was given the basic instructions on LSP as a 'hand-mind' collaboration idea that operates on individual and collective idea-building. They were given tasks to do using the LEGO bricks, and they were able to come up with seven developmental issues that the organisation they work with is facing and interested in. After the experiment, the participants' thoughts about decision-making changed as they all felt positive about it. Some participants felt this method should be employed more and some could see that they explored more options before arriving at the final solutions as compared to conventional methods. However, time was reported as a constraint because participants had to be hurried to finish up as there was not enough time. So, it can be said that the presence of LEGO alone in a place can awaken positive emotions, such as excitement and interest in people, which will encourage them to want to participate in the process. As this happens, they grow in experience day by day.

McCusker (2020) conducted a study on the theoretical foundations of LSP and its potential to elicit diverse perspectives from a variety of stakeholders in a group context. The findings of the study suggest that the use of LSP can offer a unique opportunity to access the collective wisdom of a group and uncover deeper insights into their collective thinking. Through its use of physical objects, it helps to break down hierarchical barriers and enables more open dialogue, leading to the uncovering of different perspectives. Furthermore, the study found that the LSP approach is not just limited to group activities but can also be used for individual reflection. Thus, the following hypotheses are proposed:

H7: Postgraduate students' research capacity mediates the relationship between pedagogical technique and research outcome.

H8: Postgraduate students' research capacity mediates the relationship between the use of LSP and research outcomes.

Conceptual framework. The conceptual framework in Fig. 1 showcases the roadmap and the process employed in this study for data collection and analysis.

The conceptual framework in Fig. 1 was used to guide the research design and methodology. The aim was to ensure that the study is focused and relevant to the formulated hypotheses while providing a theoretical lens through which the findings can be understood, and implications can be drawn.

Methodology

Research strategy refers to the procedure used in a study to answer the research questions using the appropriate data collection and analysis techniques (Sekaran and Bougie, 2016). The survey research strategy was adopted for this study. Ponto (2015, p. 169) suggests that "survey research can use quantitative research strategy, qualitative research strategy or both strategies (i.e., mixed methods)." The gathering of quantitative data using structured questions and qualitative data using semi-structured interviews informed the adoption of the survey research strategy for this study. Therefore, the survey strategy provided room for the use of a representative sample to explore the mediating role of postgraduate research capacity on the interplay between LSP and postgraduate students' research outcomes from which generalisations were made to the population of study.

The target population for this study is postgraduate master's degree students in the Faculty of Business and Law (FBL) of the selected university in the UK. The choice of FBL was based on the fact that master's students in this faculty were the focus of the series of workshops on LSP. The main rationale for the LSP workshops was to promote divergent thinking and creativity in social research. In other words, by engaging participants in hands-on activities, the LSP workshops helped to break down traditional modes of thinking and promote a more open-minded approach to research. The use of LEGO bricks as a common language allows for equal participation and encourages active listening and dialogue among postgraduate students from different backgrounds and disciplines within the FBL of the university. The participating students were selected from the Master of Business Administration (MBA), Human Resource Management (HRM), Project Management, Business Analytics and Marketing disciplines with the FBL of the university. The inclusion of a control group was not considered in this study as

Table 1 Reliability and validity of the latent variables.

Latent variable	Indicator	Loading	Mean	SD	Cronbach's Alpha	CR	AVE
LEGO Serious Play	LEGO1	0.724	3.568	1.386			
	LEGO2	0.859	3.459	1.199			
	LEGO3	0.851	3.378	1.171			
	LEGO4	0.864	3.297	1.087	0.869	0.897	0.653
	LEGO5	0.729	3.162	0.973			
Pedagogical Technique	PT1	0.636	3.351	1.019			
	PT2	0.833	4.000	0.930			
	PT3	0.893	3.865	1.095	0.777	0.827	0.601
	PT4	0.715	3.784	0.904			
Research Capacity	RC3	0.749	4.027	0.822			
	RC4	0.860	3.838	0.789			
	RC5	0.845	3.703	0.955	0.823	0.832	0.653
	RC8	0.771	3.622	0.911			
Research Outcome	RO1	0.827	3.378	0.996			
	RO2	0.963	3.486	1.003			
	RO4	0.935	3.432	1.079			
	RO5	0.952	3.541	0.947			
	RO6	0.931	3.486	1.030			
	RO7	0.882	3.568	1.001			
	RO8	0.898	3.432	0.974	0.967	0.973	0.835

SD standard deviation, *CR* composite reliability, *AVE* average variance extracted.
Source: Emerged from SmartPLS analysis.

it would require withholding the LSP intervention from the group of postgraduate students, which is unethical because it could potentially hinder their research development. A simple random sampling technique was used to administer questionnaires to 121 respondents from the list of participants at the LSP workshop using Jisc survey software. The rationale for the adoption of simple random sampling was based on its strength in allowing every element of the target population an equal chance of being selected to participate in the data collection process (Wilson, 2014).

Measures. The scale for the pedagogical technique was adapted from Harrington and Reasons (2005). The scale was adapted to gather data relating to the pedagogical technique covered in this study. The scale to measure LSP was developed through a collaborative research effort by authors. The initial version of the scale consisted of 15 statements that were based on the four core elements of the LSP method, which included building, storytelling, reflection, and metaphors. These statements were designed to assess the level of engagement, collaboration, creativity, problem-solving, and communication among the postgraduate students using the LSP method. The scale was tested and refined through multiple pilot tests involving 65 participants. The final version of the scale, called the Lego Serious Play survey, consists of 5 statements and is used to assess the overall experience of participants in an LSP session. The scales measuring research capacity and research outcome, which consisted of 15 statements each, were developed following a similar approach used for the LSP. The final version of the scale on research capacity consists of 4 items, while the research outcome consists of 7 items.

The 5-point Likert scale of measurement, developed in 1932 by American psychologist Rensis Likert (Wilson, 2014), was chosen to design the questionnaire. This scale varies from 1 (strongly disagree) to 5 (strongly agree) and is particularly useful for its ease of construction and interpretation of research findings. The justification for the use of the Likert scale measurement was for the ease of data collection, analysis and interpretation of the research findings.

Data analysis. The partial least squares structural model measured the reliability and validity of the latent variables. The Cronbach's alpha (CA) reliability coefficient was used to assess the construct's reliability. The CA, which was named after its inventor, Lee Cronbach, is employed in a study of this nature to determine the internal consistency of a measuring instrument (Pallant, 2020; Tavakol and Dennick, 2011). In addition, the composite reliability (CR) coefficient was equally conducted to further assess the reliability of the measuring instrument. The rationale for conducting CR after conducting CA was based on the assumption that CR is a more appropriate measure of latent variables (Ganiyu et al., 2020; Hair et al., 2014). Two categories of validity, namely convergent validity and discriminant validity, were assessed in this study. The average variance extracted (AVE) was used to assess the convergent validity. The Fronell-Larcker criterion was used to establish the discriminant validity of the latent variables (Ganiyu et al., 2020). The results of the reliability and validity of the latent variables are illustrated below.

Results

A preliminary analysis which involved exploratory factor analysis (EFA) was conducted to better understand the underlying structure of the data and identify the underlying dimensions that are driving the correlations among the latent variables measured in this study. The factor loadings for the four latent variables along with the reliability and validity on the use of LSP to enhance postgraduate research capacity are presented in Table 1.

As shown in Table 1, the CA reliability coefficient revealed that all the latent variables measured in this study are reliable. For emphasis, the alpha coefficient for LSP produced 0.869, pedagogical technique is 0.777, research capacity is 0.823 and research outcome produced 0.967. In a similar vein, the CR coefficients revealed that all the variables measured in this study are reliable, as the CR for each variable exceeds the threshold of 0.7 (Pallant, 2020; Sekaran and Bougie, 2016). The AVE that was employed in this study to establish the convergent validity revealed that all the variables are valid as the value of the AVE for each measured variable is above 0.5. Consistent with the rule of thumb, a variable is considered valid

if the value of the AVE is above 0.5 (Ganiyu et al., 2020; Hair et al., 2014; Pallant, 2020).

The Fornell-Larcker criterion used in this study to assess discriminant validity revealed that the measuring instrument did not violate discriminant validity. The Fornell-Larcker criterion is a widely used technique for assessing discriminant validity in latent variable models (Hair et al., 2019; Kock and Hadaya, 2018). It was proposed by Fornell and Larcker in 1981 and has since been extensively used in academic research and business applications ((Fornell and Larcker, 1981; Hair et al., 2019). The Fornell-Larcker criterion was employed in this study by comparing the square roots of AVE values to the inter-construct correlations. The result of the discriminant validity is presented in Table 2.

The results of the statistical analysis illustrated in Table 2 revealed that the square root of the AVE is greater than the inter-construct correlation, which is an indication that discriminant validity was not violated in this study. Based on the criterion, the square root of the AVE must be greater than the inter-construct correlation as indicated by the values in the diagonal in Table 2 (Hair et al., 2014; Kock and Hadaya, 2018). The results indicated that the square root of the AVE for each of the constructs measured in this study is greater than the inter-construct correlation. Based on these results, discriminant validity is established in this study. Figure 2 showcases the outcome of the partial least square structural equation modelling ((PLS-SEM) examining the mediating role of student research capacity.

Table 2 Discriminant validity of latent variables by Fornell-Larcker criterion.

Latent variables	LSP	PT	RC	RO
LEGO Serious Play (LSP)	**0.808**			
Pedagogical Technique (PT)	0.485	**0.775**		
Research Capacity (RC)	0.521	0.507	**0.808**	
Research Outcome (RO)	0.416	0.558	0.665	**0.914**

Note: The diagonal values in bold are the square root of the AVE.

PLS-SEM was conducted in this study for hypotheses testing and to determine the interrelationship between some specific constructs measured in this study, which include LSP, postgraduate students' research capacity, pedagogical technique and research outcome. The mediating role of postgraduate student research capacity on the interplay between endogenous latent variables (i.e., LSP and pedagogical technique) and the exogenous latent variable (i.e., research outcome) was equally examined using the PLS-SEM.

As depicted in Fig. 2, the path coefficient from LSP to pedagogical technique suggests that LSP exerts a significant positive direct effect on pedagogical technique judging from the results of the statistical analysis ($r = 0.493$, $p < 0.001$, $n = 121$). However, the path coefficient from LSP to research capacity ($r = 0.347$, $p > 0.05$, $n = 121$) suggests that LSP does not exert a significant positive direct effect on research capacity. In a similar vein, the path from LSP to research outcome ($r = 0.012$, $p > 0.05$, $n = 121$) suggests that LSP does not exert a significant effect on research outcome. The path coefficient from pedagogical technique to research capacity ($r = 0.336$, $p > 0.05$, $n = 121$) reveals that pedagogical technique does not exert a significant effect on research capacity. The R^2 value of 0.347 implies that the use of LSP and pedagogical technique jointly explain a 34.7% variance in postgraduate students' research capacity at the university surveyed. A similar study conducted by McCusker (2020) suggests that LSP is a tool that can be used to help students develop their research capacity. Research capacity in this context refers to the knowledge, skills and abilities that enable postgraduate students to

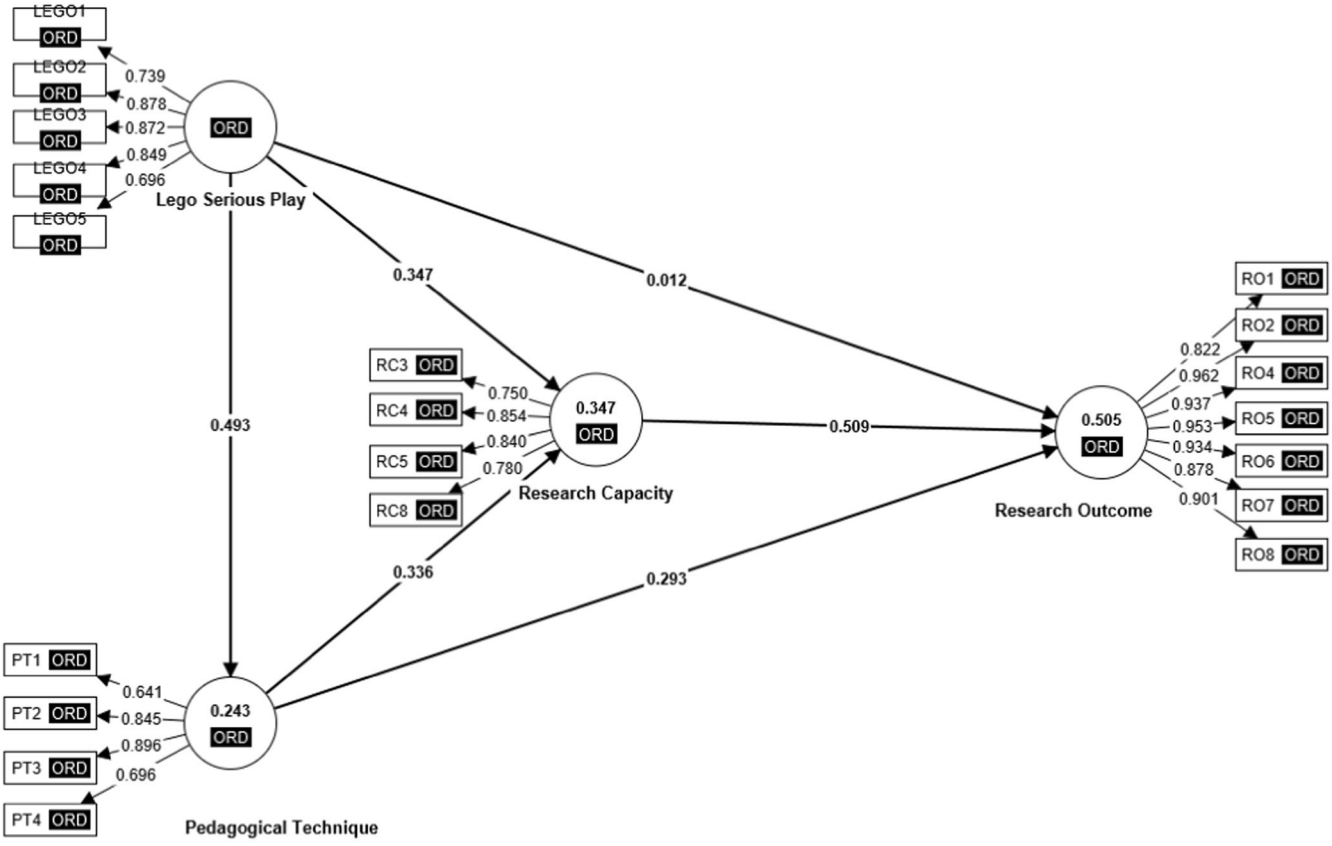

Fig. 2 Structural model.

effectively conduct research. The tool is based on the idea that students can use a combination of physical building and problem-solving to explore and develop their research skills. In other words, setting, the process of creating physical models, can allow students to think more visually and physically about the topics they are researching, making it easier to understand complex concepts. The tactile nature of the activity encourages collaboration, which can improve the quality of the research process (Harn and Hsiao, 2018). In a similar vein, a study by Gkogkidis and Dacre (2021) found that engaging in an activity involving LSP could enhance problem-solving skills, communication, and creativity. As such, it can be a helpful tool for students to use in developing their research capacity (Gkogkidis and Dacre, 2021; Harn and Hsiao, 2018).

The path coefficient from pedagogical technique to research outcome ($r = 0.293$, $p < 0.05$, $n = 121$) shows that pedagogical technique exerts a significant direct positive effect on research outcome. The path coefficient from research capacity to research outcome ($r = 0.509$, $p < 0.05$, $n = 121$) shows that research capacity exerts a significant direct positive effect on research outcome. This outcome of the statistical analysis is consistent with the finding of a similar study conducted by Supena et al. (2021) which revealed that research capacity has a significant impact on the outcome of research. Students with sufficient capacity and resources can ensure that research is conducted in an efficient and effective manner, enabling higher-quality results and greater impact (Supena et al., 2021; Varshney et al., 2016). Access to appropriate technological tools, knowledgeable staff and adequate funding can all help to ensure a successful research project (Supena et al., 2021; Varshney et al., 2016). Furthermore, research capacity can affect the number and quality of publications that result from research, as well as the impact of those publications. When research capacity is inadequate, the research process may be hindered, leading to poor results and limited impact. The R^2 value of 0.505 implies that LSP, research capacity and pedagogical technique jointly explain a 50.5% variance in the research outcome.

However, the indirect effect of pedagogical technique on research outcome via research capacity ($r = 0.171$, $p > 0.05$, $n = 121$) shows that pedagogical technique does not exert an indirect effect on research outcome via research capacity. Based on the outcome of the statistical analysis, research capacity does not mediate the relationship between pedagogical technique and research outcome. The outcome of the structural model is consistent with a similar study conducted by Ajibade and Hayes (2022), which found that students who received instruction via both a traditional and active learning approach had higher test scores than those who only received instruction via a traditional approach. Similarly, a study by Warburton et al. (2022) found that students who received instruction via both a constructivist and traditional approach had higher test scores than those who only received instruction via a traditional approach. In a similar vein, the indirect path from LSP to research outcome via research capacity ($r = 0.171$, $p > 0.05$, $n = 121$) shows that LSP does not exert an indirect effect on research outcome via research capacity. Based on this result, research capacity does not mediate the relationship between LSP and research outcome. Table 3 shows the summary of the direct and indirect effects of the exogenous latent variables on the endogenous latent variable.

The study findings illustrated in Table 4 revealed that hypothesis one (H1) was supported in this study, meaning that LSP made a significant contribution to pedagogical technique among postgraduate students at the selected university in the UK. Hypothesis two (H2) was formulated to establish if LSP exerts a significant effect on postgraduate students' research capacity. The PLS-SEM determined that LSP does not exert a significant positive effect on postgraduate students' research capacity judging from the outcome of the statistical analysis ($r = 0.347$, $p > 0.5$, $n = 121$). Therefore, H2 is not supported. Hypothesis three (H3) aimed to establish if LSP exerts a significant effect on postgraduate students' research outcomes. The results of the statistical analysis indicated that LSP does not exert a significant effect on postgraduate students' research outcomes ($r = 0.075$, $p > 0.5$, $n = 121$). Based on the outcome of the statistical analysis, H3 is rejected. In a similar vein, H4 aimed to examine if the pedagogical technique used at the university exerts a significant effect on postgraduate students' research capacity. The results of the statistical analysis revealed that the pedagogical technique used at the university does not exert a significant effect on postgraduate students' research capacity ($r = 0.336$, $p > 0.5$, $n = 121$). Therefore, H4 is not supported.

Hypothesis five (H5) was formulated to establish if pedagogical technique adopted at the university exerts a significant effect on postgraduate students' research outcomes. The analysed data revealed that pedagogical technique used at the university exerts a significant effect on postgraduate students' research outcomes judging from the outcome of the statistical analysis ($r = 0.293$, $p < 0.5$, $n = 121$). Based on the outcome of the statistical analysis, H5 is supported. Hypothesis six (H6) was formulated to determine if postgraduate students' research capacity exerts a significant effect on research outcomes. The structural model revealed that postgraduate students' research capacity exerts a significant positive effect on research outcomes ($r = 0.509$, $p < 0.005$, $n = 121$). Based on the result of the structural model, H6 is accepted.

Hypothesis seven (H7) aimed to examine the mediating role of postgraduate students' research capacity on the relationship between pedagogical technique and research outcome. The result

Table 3 Path coefficient on the effect of LEGO Serious Play on research outcome.

Latent variables	Coefficient	*T*-stat	*p*-value
LSP→Pedagogical Technique	0.493	4.037	0.000
LSP→Research Capacity	0.347	1.953	**0.051**
LSP→Research Outcome	0.012	0.075	**0.940**
Pedagogical Technique→Research Capacity	0.336	1.532	**0.126**
Pedagogical Technique→Research Outcome	0.293	2.090	0.037
Research Capacity→Research Outcome	0.509	2.871	0.004
Total indirect effects			
LSP→Research Capacity	0.165	1.396	**0.163**
LSP→Research Outcome	0.405	3.493	0.000
Pedagogical Technique→Research Outcome	0.171	1.362	**0.173**
Specific indirect effects			
Pedagogical Technique→Research Capacity→Research Outcome	0.171	1.362	**0.173**
LSP→Research Capacity→Research Outcome	0.176	1.621	**0.105**
Total effects			
LSP→Pedagogical Technique	0.493	4.037	0.000
LSP→Research Capacity	0.512	3.783	0.004
LSP→Research outcome	0.417	2.853	0.004
Pedagogical Technique→Research Capacity	0.336	1.532	0.126
Pedagogical Technique→Research Outcome	0.464	2.928	0.003
Research Capacity→Research Outcome	0.509	2.871	0.004

The values shown in bold represent relationships that are not statistically significant.

Table 4 Decisions on the tested hypotheses.

Hyp.	Specific direct effect	Coefficient	T- stat	R square	p- values	Decision
H1	LSP→ Pedagogical Technique	0.493	4.037	0.243	0.000	Supported
H2	LSP→Research Capacity	0.347	1.953	0.347	0.051	Not supported
H3	LSP→Research Outcome	0.012	0.075	0.505	0.940	Not supported
H4	Pedagogical Technique→Research Capacity	0.336	1.532	0.347	0.126	Not supported
H5	Pedagogical Technique→Research Outcome	0.293	2.090	0.505	0.037	Supported
H6	Research Capacity→Research Outcome	0.509	2.871	0.505	0.004	Supported
H7	Pedagogical Technique→Research Capacity→Research Outcome	0.171	1.362	0.505	0.173	Not supported
H8	LSP→Research Capacity→Research Outcome	0.176	1.621	0.505	0.105	Not supported

of the structural model revealed that research capacity does not mediate the relationship between pedagogical technique and postgraduate student research capacity based on the result of the specific indirect effect ($r = 0.171$, $p > 0.05$, $n = 121$). Therefore, the alternative hypothesis (H7) is rejected. This finding is inconsistent with previous empirical findings, which suggest that improving postgraduate students' research capacity with appropriate pedagogical techniques can have a direct impact on the research outcome of postgraduate students (Nkhoma et al., 2014; Van Dinther, Dochy and Segers, 2011). Furthermore, postgraduate students with higher research capacity are more likely to produce better research outcomes (Tortorella and Cauchick-Miguel, 2018). Therefore, the mediating role of postgraduate students' research capacity on the relationship between pedagogical technique and research outcome is evident.

Similarly, hypothesis eight (H8) was formulated to examine the mediating role of postgraduate students' research capacity on the relationship between LSP and research outcome. The result of the mediation analysis in the structural model revealed that research capacity does not mediate the relationship between LSP, and research outcome based on the result of the specific indirect effect ($r = 0.176$, $p > 0.05$, $n = 121$). Based on this result, the alternative hypothesis (H8) is rejected. The implication for practice is presented below.

Implication for practice. The results of the statistical analysis show that LSP has a positive impact on the pedagogical techniques used among postgraduate students at the selected university in the UK. The practical implication for educators, therefore, is that incorporating LSP in their teaching can enhance students' creative thinking abilities and enable them to generate innovative solutions for complex problems. This is particularly beneficial for postgraduate researchers who are often required to think critically and develop original research ideas and methods. It is imperative for educators to recognise and utilise the potential of LSP as a valuable tool because of the inclusivity of LSP to promote a diverse range of perspectives and ideas to be shared within the learning process, thereby fostering a more comprehensive and well-rounded approach to education.

By utilising the insights gained from the significant relationship between pedagogical technique and research outcome, there is an opportunity to enhance the research capacity of postgraduate students and improve the overall quality of their research outcomes. After observing that the postgraduate students at the selected university favour using LSP to contextualise research concepts, the institution's management may consider engaging educators to incorporate LSP into the pedagogical approach in order to promote and encourage research among these students. This implementation could lead to an overall improvement in the postgraduate students' research capacity and subsequently, the quality of their research outcomes. By recognising the significant association between pedagogical techniques and research outcomes, this strategy has the potential to enhance the educational experience for postgraduate students and lead to more impressive research results. This approach is consistent with the principles of constructivist theory, which emphasises hands-on, experiential learning and the importance of active participation in the learning process. LSP is a prime example of a constructivist approach to learning, as it engages learners in constructing their own knowledge and understanding through the use of hands-on materials and creative thinking.

Limitations of the study and suggestions for future research. The study focused on one university in the UK which limits the ability to generalise the research findings to other higher education institutions (HEI) in the UK. Future research may replicate the study to other HEI in the UK to validate the research outcome. In addition, employing self-report measure and cross-sectional data may result in common method biases and restrict causal interpretations.

Conclusion

LSP, as a research tool, uses creative problem-solving and reflective questioning to facilitate collective understanding and decision-making. It is a process that involves building physical models with LEGO bricks, which are then used to explore and discuss topics related to an individual or group's professional or personal development. The main idea behind LSP is that the act of building the models helps to unlock the creativity of the individual or group, allowing for more open and honest dialogue. It also encourages different perspectives, as the models are used to represent different opinions and experiences. The study contributed to the frontier of knowledge by examining the use of LSP to enhance postgraduate research capacity using a selected university in the UK as a reference point. To answer the research questions, eight hypotheses were formulated and tested using PLS-SEM. The analysed data revealed a significant relationship between LSP and postgraduate students' research capacity. However, the mediation analysis conducted using the bootstrapping method suggested that research capacity did not mediate the relationship between LSP and research outcome.

Data availability

The data set is accessible through the Humanities and Social Sciences Communications Dataverse repository via: https://doi.org/10.7910/DVN/SFVC2V.

Received: 8 December 2023; Accepted: 14 October 2024;
Published online: 19 February 2025

References

Ajibade BO, Hayes C (2022) Using LEGO® Serious Play® Methodology in supporting Nigerian nursing students' sociocultural transitions to UK higher education: a phenomenological research study. Nurse Educ Today 119:1–14. https://doi.org/10.1016/j.nedt.2022.105582

Biggs J (1996) Enhancing teaching through constructive alignment. High Educ 32(3):347–364. https://doi.org/10.1109/educon.2018.8363281
Bodnar CA, Anastasio D, Enszer JA et al. (2016) Engineers at play: games as teaching tools for undergraduate engineering students. J Eng Educ 105(1):147–200. https://doi.org/10.1002/jee.20106
Brown S, Vaughan C (2010) Play: how it shapes the brain, opens the imagination and invigorates the soul. New York: NY, Penguin
Codur K, Karataş S, Doğru A (2012) Application of project-based learning in a theoretical course: process, difficulties and recommendations. Int J Eng Educ 28(1):17–25. https://hdl.handle.net/11511/54107
Cheong KH, Koh JM (2018) Integrated virtual laboratory in engineering mathematics education: Fourier theory. IEEE Access 6:58231–58243. 0.1109/ACCESS.2018.2873815
Cheong KH, Koh JM, Yeo DJ et al. (2019) Paradoxical simulations to enhance education in mathematics. IEEE Access 7:17941–17950. https://doi.org/10.1109/ACCESS.2019.2892742
Dacre N, Constantinides P, Nandhakumar J (2015) How to motivate and engage generation clash of clans at work? Emergent properties of business gamification elements in the digital economy. International Gamification for Business Conference (IGBC15), Birmingham, UK
Dann S (2018) Facilitating co-creation experience in the classroom with Lego Serious Play. Australas Mark J 26(2):121–131. https://doi.org/10.1016/j.ausmj.2018.05.013
Duckworth E (2006) The having of wonderful ideas and other essays on teaching and learning. Teachers College Press
Edmondson A (1999) Psychological safety and learning behavior in work teams. Adm Sci Q 44(2):350–383. https://doi.org/10.2307/2666999
Fornell C, Larcker DF (1981) Evaluating structural equation models with unobservable variables and measurement error. J. Mark. Res 18(1):39–50
Ganiyu IO, Fields Z, Atiku SO et al. (2020) Measuring the effectiveness of work–life balance strategies in the manufacturing sector. SA J Hum Resour Manag 18(1):1–10. https://hdl.handle.net/10520/EJC-1fa43a17d6
Gkogkidis V, Dacre N (2021) Exploratory learning environments for responsible management education using Lego Serious Play. SBS Working Paper Series. https://doi.org/10.5281/zenodo.4639572
Grienitz V, Schmidt AM (2012) Scenario workshops for strategic management with Lego® Serious Play®. Probl Manag 21st Century 3:26–35
Hair JF, Risher JJ, Sarstedt M, Ringle CM (2019) When to use and how to report the results of PLS-SEM. Eur Bus Rev 31(1):2–24. https://doi.org/10.1108/EBR-11-2018-0203
Hair Jr JF, Sarstedt M, Hopkins L, Kuppelwieser VG (2014) Partial least squares structural equation modeling (PLS-SEM): an emerging tool in business research. Eur Bus Rev 26(2):106–121. https://doi.org/10.1108/EBR-10-2013-0128
Hale Feinstein A, Mann S, Corsun DL (2002) Charting the experiential territory: clarifying definitions and uses of computer simulation, games, and role play. J Manag Dev 21(10):732–744. https://doi.org/10.1108/02621710210448011
Hansen P K (2012) Innovation and learning facilitated by play. In N.M Seel (Ed.) Encyclopedia of the Sciences of Learning. pp. 1569–157, Springer, Germany
Harrington CF, Reasons SG (2005) Online student evaluation of teaching for distance education: a perfect match. J Educators Online 2(1):1–12
Harn PL, Hsiao CC (2018) A preliminary study on LEGO®-based workplace stress reduction with six bricks and LEGO® SERIOUS PLAY® in Taiwan. World J Res Rev 6(1):64–67
Hayes C, Graham Y (2020) Understanding the building of professional identities with the LEGO® SERIOUS PLAY® method using situational mapping and analysis. High Educ Skills Work-Based Learn 10(1):99–112. https://doi.org/10.1108/HESWBL-05-2019-0069
Heikkinen S, Nemilentsev M (2014) Lego Serious Play as an innovative method of learning. Innovative Teaching and Learning Methods in Multicultural Environments. Mikkeli University of Applied Sciences, Mikkeli. pp. 18–26
James AR (2013) Lego Serious Play: a three-dimensional approach to learning development. J Learn Dev High Educ (6):1–18. https://doi.org/10.47408/jldhe.v0i6.208
Kerr B (2015) September. The flipped classroom in engineering education: a survey of the research. In: 2015 International Conference on Interactive Collaborative Learning (ICL). IEEE. pp. 815–818
Kock N, Hadaya P (2018) Minimum sample size estimation in PLS-SEM: the inverse square root and gamma-exponential methods. Inf Syst J 28(1):227–261. https://doi.org/10.1109/ICL.2015.7318133
Kurkovsky S (2015) June. Teaching software engineering with LEGO Serious Play. In: Proceedings of the 2015 ACM Conference on Innovation and Technology in Computer Science Education. ACM. pp. 213–218
Kurkovsky S (2018) July. Using LEGO to teach software interfaces and integration. In: Proceedings of the 23rd Annual ACM Conference on Innovation and Technology in Computer Science Education. pp. 371–372. https://doi.org/10.1145/3197091.3205831
Liang DNY, Yun FNJ, Minato N (2021) Investigating the use of LEGO® in education and training: a systematic literature review. J Appl Learn Teach 4(1):107–113. https://doi.org/10.37074/jalt.2021.4.1.17
Lopez-Fernandez D, Gordillo A, Ortega F et al. (2021) Lego® Serious Play in software engineering education. IEEE Access 9:103120–103131. https://doi.org/10.1109/ACCESS.2021.3095552
López-Pernas S, Gordillo A, Barra E, Quemada J (2019) Analyzing learning effectiveness and students' perceptions of an educational escape room in a programming course in higher education. IEEE access 7:184221–184234
McCusker S (2020) Everybody's monkey is important: LEGO® Serious Play® as a methodology for enabling equality of voice within diverse groups. Int J Res method Educ 43(2):146–162. https://doi.org/10.1080/1743727X.2019.1621831
Nerantzi C (2018) LEGO® SERIOUS PLAY® as an affective experience in doctoral researchers' support: Tensions and new freedoms. Int J Manag Appl Res 5(4):290–303
Nerantzi C, McCusker S (2014) April. A taster of the LEGO® SERIOUS PLAY® method (LSP) for higher education. In: Conference: OER14 Building Communities of Open Practice, At Centre for. http://www.medev.ac.uk/oer14/19/view/
Nkhoma M, Sriratanaviriyakul N, Pham Cong H et al. (2014) Examining the mediating role of learning engagement, learning process and learning experience on the learning outcomes through localized real case studies. Educ + Train 56(4):287–302
Nurhuda A, Al Khoiron MF, Azami YSI, Ni'mah SJ (2023) Constructivism learning theory in education: characteristics, steps and learning models. Res Educ Rehabilitat 6(2):234–242. https://doi.org/10.51558/2744-1555.2023.6.2.234
Pallant J (2020) SPSS survival manual: a step by step guide to data analysis using IBM SPSS. Routledge
Ponto J (2015) Understanding and evaluating survey research. J Adv Practitioner Oncol 6(2):168–171
Román-Ibáñez V, Pujol-López FA, Mora-Mora H et al. (2018) A low-cost immersive virtual reality system for teaching robotic manipulators programming. Sustainability 10(4):1–13
Roos J, Victor B (2018) How it all began: the origins of LEGO® Serious Play®. Int J Manag Appl Res 5(4):326–343. https://doi.org/10.18646/2056.54.18-025
Sekaran U, Bougie RJ (2016) Research methods for business: a skill building approach. 7th edition, John Wiley & Sons
Stubbs W, Cocklin C (2008) Teaching sustainability to business students: shifting mindsets. Int J Sustain High Educ 9(3):206–221. https://doi.org/10.1108/14676370810885844
Supena I, Darmuki A, Hariyadi A (2021) The Influence of 4C (constructive, critical, creativity, collaborative) learning model on students' learning outcomes. Int J Instr 14(3):873–892. https://doi.org/10.29333/iji.2021.14351a
Tavakol M, Dennick R (2011) Making sense of Cronbach's alpha Int J Med Educ 27(2):53–55. https://doi.org/10.5116/ijme.4dfb.8dfd
Tortorella G, Cauchick-Miguel PA (2018) Teaching lean manufacturing at a postgraduate level: integrating traditional teaching methods and problem-based learning approach. Int J Lean Six Sigma 9(3):301–323. https://doi.org/10.1108/IJLSS-08-2017-0101
Van Dinther M, Dochy F, Segers M (2011) Factors affecting students' self-efficacy in higher education. Educ Res Rev 6(2):95–108. https://doi.org/10.1016/j.edurev.2010.10.003
Varshney D, Atkins S, Das A et al. (2016) Understanding collaboration in a multinational research capacity-building partnership: a qualitative study. Health Res Policy Syst 14:1–10. https://doi.org/10.1186/s12961-016-0132-1
Warburton T, Brown J, Sandars J (2022) The use of LEGO® SERIOUS PLAY® within nurse education: a scoping review. Nurse Educ Today 118:1–09. https://doi.org/10.1016/j.nedt.2022.105528
Wengel Y, McIntosh A, Cockburn-Wootten C (2021) A critical consideration of LEGO® SERIOUS PLAY® methodology for tourism studies. Tour Geogr 23(1-2):162–184
Wheeler S, Passmore J, Gold R (2020) All to play for: LEGO® SERIOUS PLAY® and its impact on team cohesion, collaboration and psychological safety in organisational settings using a coaching approach. J Work-Appl Manag 12(2):141–157. https://doi.org/10.1108/JWAM-03-2020-0011
Wilson J (2014) Essentials of business research: A guide to doing your research project. Sage, UK
Zenk L, Hynek N, Schreder G et al. (2018) Designing innovation courses in higher education using LEGO® SERIOUS PLAY®. Int J Manag Appl Res 5(4):245–263

Author contributions

All authors have made equal contributions to this study.

Competing interests

The authors declare no competing interests.

Ethical approval

This study was ethically reviewed by the FBL Ethics Committee of the University of Northampton with approval granted on July 1st, 2022. All procedures in this study were in accordance with the institutional research and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all the participants in this study, and the confidentiality of the participants was ensured in accordance with the UK DPIA guidelines.

Additional information

Supplementary information The online version contains supplementary material available at https://doi.org/10.1057/s41599-024-03930-5.

Correspondence and requests for materials should be addressed to Idris Olayiwola Ganiyu.