

Fostering Engagement and Inclusive Learning: The Impact of Lego Based Learning Activity in Mechanical Science module

Izzati Ibrahim, University of Southampton, ibi1y21@soton.ac.uk

Abstract

A Lego based learning activity has been introduced to the Mechanical Science module in the Engineering Foundation Year at the University of Southampton. The implementation of Lego based learning was to promote student engagement, enhance student's teamwork skills and foster a sense of belonging within the module. Given the diverse academic backgrounds and abilities of foundation year students, this case study explores how integrating Lego into the curriculum can promote inclusive learning and enhance student performance in a cognitively demanding module. Using Lego to simulate real-world engineering applications highlights the relevance of the subject matter, while creating an engaging and interactive learning environment. During the activity, students worked collaboratively and applied their newly acquired mechanics knowledge to solve engineering challenges. This teamwork encouraged peer interaction, the sharing of ideas, and celebration of group achievements, which helped strengthen their sense of community within the module. The effectiveness of the activity was evaluated through the student's feedback and author's observation, focusing on whether the learning environment was engaging, supportive and inclusive to students with diverse backgrounds, skills, and learning preferences.

Introduction

Lego based learning has been introduced in Mechanical Science module for Engineering Foundation year (EFY) to enhance student engagement and sense of belonging in a challenging academic context. Foundation year students consist of diverse groups of students that have different academic background, learning preferences and abilities. An inclusive learning environment is essential to support students' engagement and academic success, ensuring that all learners have equal opportunities in education (Sharma, 2024). As Prananto et al. (2025) states, when students feel valued and supported in their learning journey, they are more likely to engage with the subject matter. Research conducted by Walton and Cohen (2011) has shown that when students feel a sense of belonging, it fosters emotions that lead to improved achievement in learning.

Foundation year programme is an intensive programme for students to attend before progressing to their chosen degree. For some students, the significant transition from school to higher education might lead to challenging and overwhelming emotions that can affect their learning experiences (Goldring et al., 2018; McMillan, 2013). To increase feelings of community, the educator needs to create an inclusive and positive learning environment to help students to adapt to their new education setting much faster. Research conducted by Quin (2017) has shown that when students feel accepted, it can create strong relationships with peers and teachers, which significantly impacts students' learning outcomes. Students who feel connected to their peers will be more effective in teamwork, as they feel more

comfortable to express their ideas, accepting other teams' opinions and engaging in discussion (Aliano and Chang, 2024; Juvonen, Espinoza and Knifsend, 2012).

Implementing design-based learning in the foundation year can be challenging due to the diverse academic backgrounds, skills, and learning needs of students. However, design-based learning is an important method for enhancing students' understanding of the subject matter and improving their problem-solving skills in engineering (Oo *et al.*, 2024). Studies have shown that design-based learning can improve student engagement, strengthen their skills, and foster collaboration (Geitz and Guez, 2019). It is also beneficial for students who are not keen on traditional styles of learning. To support the implementation of design based learning in engineering foundation year, Lego was used as a tool to create an interactive, inclusive and positive learning environment during the design-based learning process.

Lego based learning is known as a fun and playful activity where the students will actively design, explore and experiment using the Lego pieces (Wheeler, 2023; James, 2013). Lego based learning, also known as Lego Serious Play (LSP), has been widely used as a tool to promote active learning and improve student's engagement in higher education (Ferreira *et al.*, 2024). At London College of Fashion, LSP was used as a strategy to drive students' reflections upon their learning journey (James, 2013). In engineering, Lego has been used as an interactive activity to enhance students' problem-solving skills in robotics and manufacturing (Lugaresi, Frigerio and Matta, 2020; Danahy *et al.*, 2014; Souza *et al.*, 2018). Lego has also been widely used in promoting deep learning in STEM subjects (Li *et al.*, 2015; Hussain *et al.*, 2006; Ozgun Koca, 2015). Disseler and Mirand (2017) have shown that Lego based learning can create a positive impact on students learning as students are able to tackle complex real world problems in a fun, creative and engaging way.

Moreover, research has shown that when students feel positive about their learning experiences, their engagement increases and improves knowledge retention of the subject matter (Hernick and Jaworska, 2018; Anderman and Dawson, 2011). Many educators have embedded engaging and interactive activities within their suite of teaching practices. For example, video games have been used in interactive learning to induce deeper understanding among students in engineering subjects (Coller and Scott, 2009; Schimpf, 2021). Research by Rivera and Garden (2021) has shown that implementing games in learning (gamification), not only promotes engagement but also improves students wellbeing and sense of belonging within the module (Rivera and Garden, 2021).

In addition, Lego based learning can help to facilitate students with diverse learning preference and abilities. It is possible that students with special needs and/or less interest in traditional styles of learning will enjoy and learn more through this type of activity. The reason behind this is because this activity involves multisensory skills and active learning which might help to improve students focus and communication (Lindsay, Hounsell and Cassiani, 2016). During the activity, students can learn and express themselves in a creative way while developing their knowledge and skills through the exploration of the problem.

The Lego based learning activity in EFY was planned to involve collaboration and teamwork. Through this activity, students are exposed to diverse perspectives and approaches to problem-solving (Gardiner, 2020; He, 2023). The students work as a team in designing, testing

and analysing their approach in achieving the goal of the activity. Working as a group can help students to improve their skills to communicate effectively with their team members, work together to achieve the goal of the activity, share ideas and respect each other's contributions. By collaborating, students can tackle complex problems that might be too challenging for an individual, promoting critical thinking and innovation (Azizan and Shamsi, 2022).

Implementation of Lego based learning

The main aim of Lego based learning was to introduce the students to the concept of design and problem based learning. The sessions were run at the end of Semester 1 and took about 4 hours per session. This learning activity consists of five phases which students must complete: (i) design, (ii) testing, (iii) measurement, (iv) calculation and (v) reflection/presentation (Figure 1).

During the design phase, the students worked in pairs in designing a Lego car that is powered by a rubber band. The students were required to use the provided Lego pieces and were not allowed to bring Lego pieces from home to ensure fairness among the students during the activity. The design had to meet specific criteria: (1) the car must travel at least 2 meters in a straight line on a track, and (2) it can only be powered by a rubber band.

Once students had constructed and tested their car designs, they proceeded to the measurement and calculation phases of the activity. During the measurement phase, the students used a stopwatch to record the time (in seconds) it took for the car to travel 2 meters along the track. Students were required to take measurements on two different surfaces such as carpet, wood floor or concrete floor (Figure 2). Through these measurements, the students explored mathematical equations and applied theoretical concepts to determine the potential energy stored in a rubber band. The students also utilised knowledge that they have learned from other modules such as conducting experiments, selecting appropriate measurement equipment and calculating the propagation of uncertainties of each parameter.

After completing the measurement and calculation tasks, the students reflected on their achievement during the Lego based learning. Through this reflection, the students discussed the challenges that they faced during each phase, their approaches in overcoming the challenge and the new skills or knowledge that they have learned through this activity.

In order to encourage students to be creative and competitive in their design, the 'Best Design Award' and the 'Fastest Car Award' were introduced during the session. These awards fostered deeper creativity among the students and helped prevent similarity in the designs. Figure 3 shows an example of the Lego cars designed by the EFY students during the Lego based learning activity. From the figure, we can see the distinctiveness of each of the designs. During the design phase, the students observed other teams, gave their opinions about the design and negotiated trading or swapping of Lego pieces between student pairs.

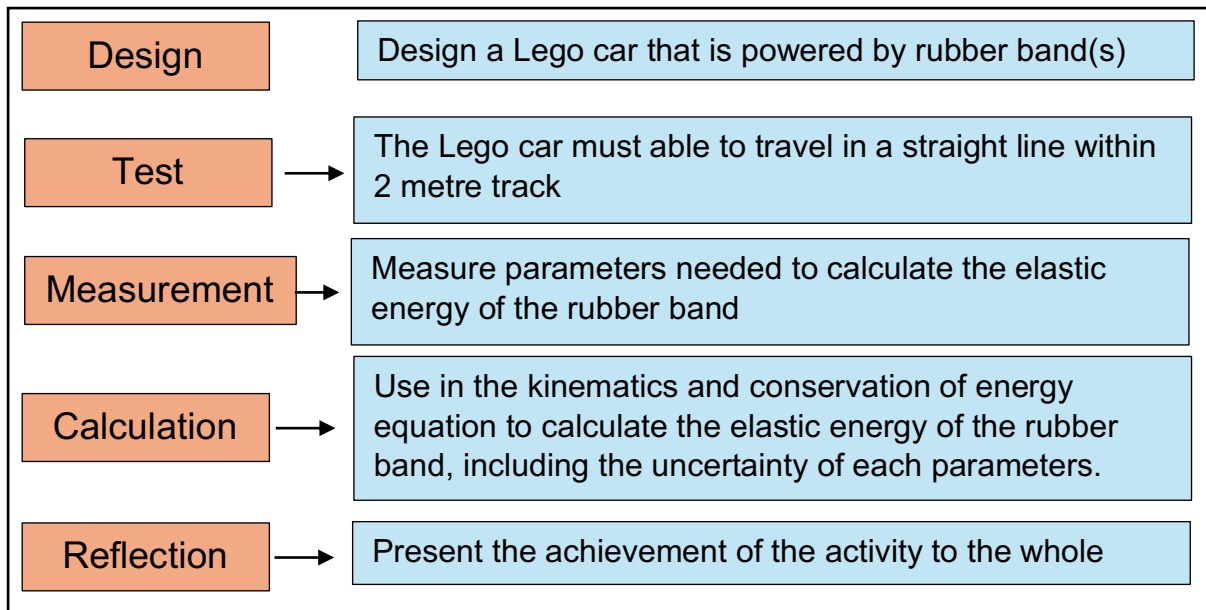


Figure 1: Summary of the five phases of Lego based learning (or LSP)



Figure 2 Shows one of the students testing the Lego car on the wooden floor. The students were given flexibility in choosing the type of surface for their experiment

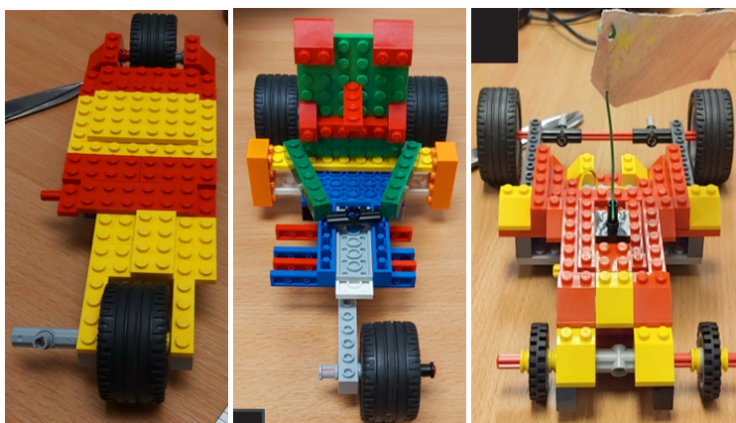


Figure 3: Example of the Lego cars design by EFY students during the Lego based learning

Findings

The effectiveness of Lego based learning in creating an engaging and inclusive learning environment was evaluated through qualitative results based on student's feedback and teacher observation. The questionnaire consisted of scale-based questions that measured the level of agreement or disagreement with specific statements, as shown in Figure 4 and Figure 5. Its purpose was to assess to students' perceptions of the impact of the Lego activity on their understanding and motivation in learning, perceived teamwork skills and sense of belonging within the module. The students were also asked to rate their experience in teamwork as either as 'Poor', 'Not bad', 'Good' or 'Excellent' to evaluate their level of collaboration and overall satisfaction with group work. At the end of the questionnaire, there was an open question to allow students to share their opinions and views on the experience such as:

- 1) Did you learn anything form this Lego based activity? If yes, what did you learn?
- 2) Did you feel comfortable expressing your ideas/opinions during the activity? (Please elaborate on yes or no answer)
- 3) Do you want to say anything else about the Lego based learning activity?'

Student's Feedback

Ninety four students completed the Lego based learning activity. The impact of this activity upon students' learning was assessed at the conclusion of the activity via distribution of a feedback survey. From the engagement feedback, 97% of students agreed that they enjoyed the activity (Figure 4). From the open question feedback, one particular reason mentioned was that the students liked the hands-on aspect of the activity, which linked theory that they learned in the Mechanical Science module to a practical application. One student noted that the activity helped them recall the calculations learned in the module and apply them to a real world problem in a fun environment.

From the feedback, 92% of students agreed that the activity has helped them better understand about the fundamentals of the module (Figure 4). From the open question feedback, most students mentioned that the topic they have learnt more about was applying the propagation of uncertainty in calculations. One student stated this activity has helped them to link the propagation of uncertainty into a real world application. Additionally, 88% of students agreed that Lego based learning improved their motivation in learning Mechanical Science module (Figure 4). One student stated that the activity induced excitement and made them curious to learn more about the topics. Two students suggested that the activity should be extended to different topics within the module, such as designing a bridge or exploring dynamics in rotational motion.

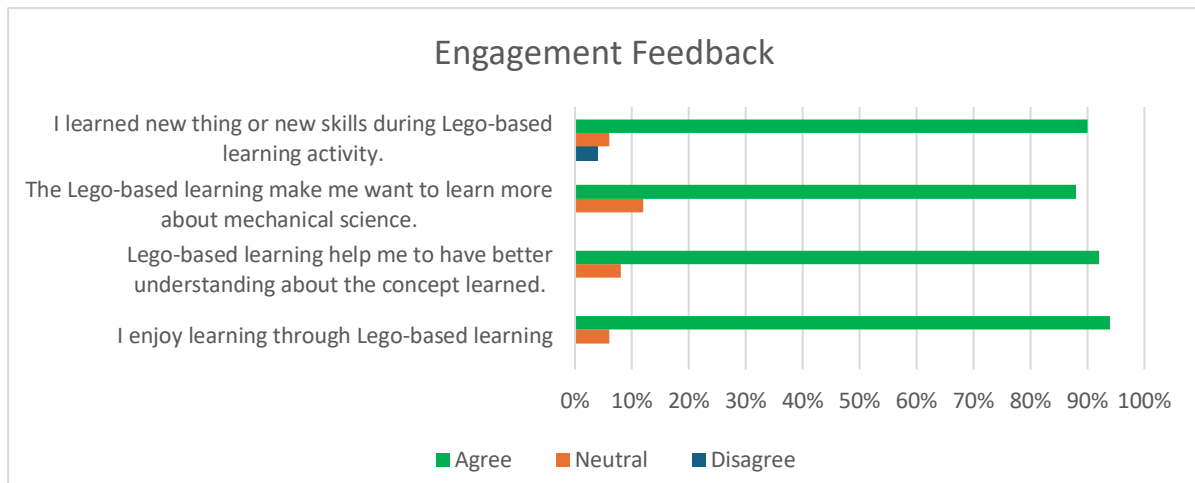


Figure 4: Lego based learning student's feedback on engagement

In addition, 90% of students agreed that they learned new skills during the session (Figure 4). One student stated that the Lego based learning activity helped them be creative in constructing a rubber band powered Lego car, apply the principles of aerodynamics to make the car go faster, and incorporate uncertainty into calculations. From the open question feedback, one student noted they developed problem solving skills and learned from their mistakes. For instance, they noted that errors made during group work helped them to improve their design. About 4% of students disagreed that they learned new knowledge or skill through the activity, with one of the reasons being that they felt that the design based learning using Lego was just for fun.

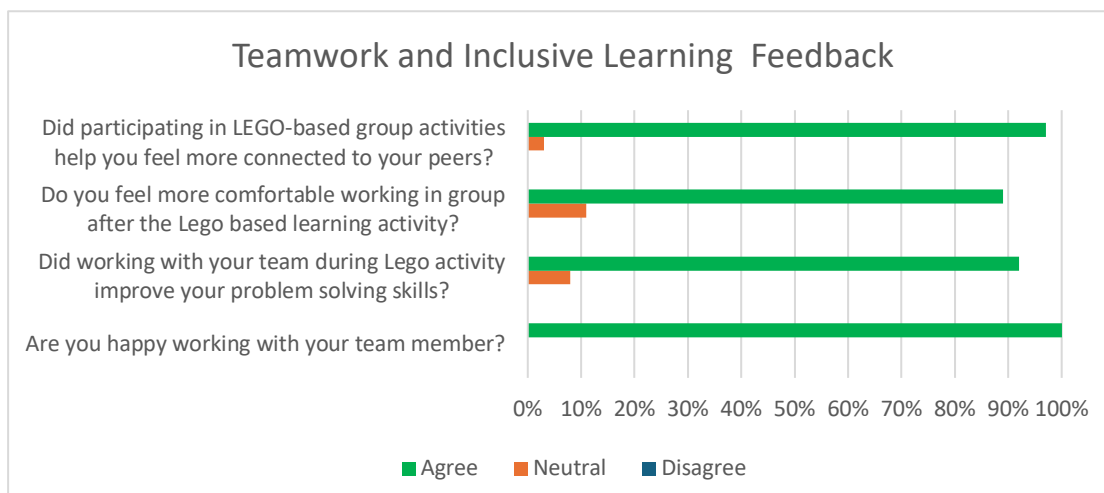


Figure 5: Lego based learning student's feedback on team work and sense of belonging

For feedback on teamwork and sense of belonging, 100% of students agreed that they were happy working with their team (Figure 5). 85% of students rated the quality of their relationship within the team as 'Excellent', while 15% rated as 'Good'. None of students rated as 'Not bad' or 'Poor'. Also, 92% agreed that working as a team has helped to improve their problem solving skills (Figure 5). From the open question feedback, one student stated that by working as a team, they were able to complete the tasks in time. Another group stated that the discussion between the members of the team helped the group to identify what they have done wrong and how to improve their design.

In addition, 89% of students feel more comfortable to work in groups after the Lego based learning, Figure 5. From the open question feedback, most students stated that their ideas and opinions were heard, and they enjoyed working as a team during the activity. Some groups stated that the discussion between the team members was comfortable because they were all having fun. Also, 97% of students agreed that the activity made them feel more belonging within the module, Figure 5. Most of them mentioned that this activity improved their confidence to participate more within the module. They stated that they were having fun while working on the activity.

Teacher Observations

During the Lego based learning, it was observed that all the students were engaged from the beginning to the end of the activity. As soon as the students were given the go-ahead, the students eagerly moved around, gathering the Lego pieces they needed and began working on their designs. Throughout the entire 4-hour session, the students remained actively engaged, working diligently and discussing their designs and measurements. The Lego based learning activity proved successful, as all students managed to complete their task and present their reflections at the end of the final session.

Some students initially struggled to design the car due to a lack of experience in working with Lego. However, with support from the teaching assistants, the students were able to get started and gradually develop their Lego car design. The students were guided with cognitive questions to help them think through the process of assembling the Lego pieces. Once the students completed their designs and the task, they all participated enthusiastically and had fun during the Lego car race.

Completing all five phases of the activity (design, test, measurement, calculation and reflection) within four hours may be physically tiring and cognitively stressful for some students. It may be necessary for teaching assistants to prompt students to take breaks. During the activity, refreshments were provided to help students relax and have a break. This allowed them to regain energy and stay engaged in subsequent tasks. Additionally, teaching assistants must also monitor the time to ensure that students do not spend too much time on a single phase task, as they need to complete all phases to achieve the learning objectives.

Discussion

When students struggle with their learning there can be several consequences which can impact social, emotional and cognitive engagement. Students might feel stressed and overwhelmed, which in turn may cause a reduction in their interest in the subject matter (Pietarinen et al, 2014). Due to this, the Lego based learning was introduced in Engineering Foundation Year at University of Southampton in order to create fun learning which might help in improving students sense of belonging and engagement within the module. As the module requires students to advance their understanding of structure, forces and energy, Lego pieces are suitable tools to improve students imagination, creativity and building their cognitive challenge about the engineering topics (Ferreira *et al*, 2024). The results from Figure 4 highlighted a strong sense of engagement that could be attributed to the hands on activity

from Lego based learning that allowed students to directly apply theoretical knowledge to practical applications. With 88% of students reported increased motivation, this suggests that the Lego based learning fostered an enjoyable and stimulating learning experience that led to an increase in student engagement within the module.

Based on feedback, overall students had a positive experience from the Lego based learning activity. From Figure 4, 97% of students agreed that the activity was fun and through it they were able to link their creativity and prior knowledge to solve real world problems. Also from Figure 4, 92% of students stated that the activity enhanced their understanding of fundamental concepts, it is evident that hands-on and interactive learning through Lego based learning deepened students' connection and engagement to the subject matter. Furthermore, as students suggested to extend the activity to other topics, demonstrated their sense of ownership in the learning process. Research conducted by Cannata, Reading and Nguyen (2016) showed that when students feel welcomed to express their ideas and actively participate in their learning, it indicates that students have taken ownership of their learning, which in turn increases engagement and sense of belonging within the module.

However, in order to ensure the effectiveness of Lego based learning in engineering education, it is essential to closely align the activity with the core concepts of the subject being taught. This enables students to apply their newly acquired knowledge in each task within the activity which can help in improving any gaps in understanding of the subject matter. Moreover, Lego based activities should serve as a complementary tool which is designed to enhance student motivation and engagement in learning. The traditional teaching method is still important for students to learn the new concept of the engineering theory. By integrating the hands-on and interactive tasks to reinforce the principles of the engineering topics, the student learning can be more dynamic and effective as they are able to apply the theory they have learned in a creative way (Joordens et al. 2012).

The teamwork skills that the students developed through the activity helped improve students' confidence in working as a team. As shown in Figure 5, feedback strongly indicates that the Lego based learning activity enhanced students' teamwork skills. This improvement may be attributed to the nature of the Lego activity that is fun which keeps students engaged, making teamwork feel enjoyable rather than forced. The activity was designed to help students to gain experience and skills in working together, communicate effectively with the team members, share responsibilities in achieving the goal of the activity and compete with other groups in a positive way. These skills are important when the student's progress to their undergraduate degrees or employment. According to students' reflection, many were initially nervous to work together to complete the task. However, after the session, almost all students felt confident in teamwork and valued the other member's contributions. This activity has helped students to build relationships with their peers, which encouraged the sense of community within the module (He, 2023).

The feedback from Figure 5 further supports the success of the activity in fostering a sense of belonging within the module. As one hundred percent of students agreed that they were happy working with their team (Figure 5), this shows that the Lego based activity fostered strong relationships within teams and contributed to a sense of community. As 97% of students enjoyed the activity and found it connected theory to practice, this indicates the

increased sense of belonging and engagement within the module (Figure 5). As Hernik and Jaworska (2018) stated, enjoyment is a key factor in creating a positive learning environment where students feel comfortable and included. During the Lego based learning, all student had fun which might lead to them feeling connected to the activity, their peers, and the learning environment as a whole. The hands-on, interactive nature of the Lego activity makes it engaging and enjoyable, which helps students feel they are part of a collaborative and supportive module.

One issue that is important to highlight in Lego based learning is to ensure that the students are well prepared before they participate in the activity. During the activity, the students need to complete five tasks that involve multidisciplinary subjects. As the activity requires students to apply concepts they have previously learned to solve a problem, some students may struggle to make these connections if they are not adequately prepared. This can lead to confusion or frustration, that might potentially affect the group's progress. Also, not all students have the same level of access to Lego at home. Some students will not feel comfortable in putting the Lego pieces together. In order to create an inclusive environment, the teacher must be mindful of the students ability and provide guidance and assistance during the design task.

In order to ensure effective collaboration within the team, the teaching assistants (where present and/or available) should monitor the contribution and interaction of each team members during the activity. One issue that might arise is unequal participation within the group. In some cases, one student may take on the majority of the work, while others contribute minimally. To address this, teaching assistants must provide guidance, encouraging all students to participate fully and collaborate effectively to complete the task.

Conclusion

The Lego based activity has been introduced to the Mechanical Science module in the Engineering Foundation Year at the University of Southampton. This activity proved to be highly effective in promoting student engagement, teamwork, and a sense of belonging. Feedback from students highlighted the success of the hands-on approach, with most students stating improved understanding of core module concepts through the activity. Furthermore, the activity has also increased student's confidence in teamwork, with all students rating their team relationships as positive. The activity fostered collaboration and helped students connect theoretical concepts with practical applications, creating a more engaging and inclusive learning environment. However, challenges such as lack of preparation and unequal participation within the team, has been highlighted and discussed. Despite these challenges, the overall positive impact on student learning and engagement suggests that the Lego based learning is a valuable tool for enhancing the engagement and learning experience in engineering education.

References

- Aliano, K.I. Chang, D. (2024). 'Collaboration and Teamwork: Peer Interaction in the Classroom', In: *Teaching Writing Through Theatre*. Palgrave Macmillan, Cham.
- Anderman, E.M. and Dawson, H. (2011). 'Learning with motivation'. *Handbook of Research on Learning and Instruction*. pp.219 -241. New York, NY: Routledge.
- Azizan, S. A. and Shamsi, N. A. (2022), 'Design-Based Learning as a Pedagogical Approach in an Online Learning Environment for Science Undergraduate Students', *Frontier in Education Journal*, 7 – 860097, pp. 1-7. DOI:10.3389/educ.2022.860097
- Cannata, M., Redding, C. and Nguyen, T. D. (2016), 'Building Student Ownership and Responsibility: Examining Student Outcomes from a Research', In: Annual meeting of the Association of Education Finance and Policy, Denver, CO, 17-19 March, 2016.
- Coller, B. and Scott, M. J. (2009) 'Effectiveness of using a video game to teach a course in mechanical engineering' *Computers and Education Journal*, 53 (3), pp 900 – 912. DOI: <https://doi.org/10.1016/j.compedu.2009.05.012>
- Danahy, E., Wang, E., Brockman, J., Carberry, A., Shapiro, B. and Rogers, C. B. (2014) 'Lego-based Robotics in Higher Education: 15 Years of Student Creativity', *International Journal of Advanced Robotics Systems*, 11, pp. 27 - 1 – 15. DOI: 10.5772/58249
- Disseler, S. and Mirand, G. (2017) 'Students with disabilities and LEGO® education.' *Journal of Education and Human Development*, 6(3), pp. 38-52.
- Ferreira, C., Robertson, J., Pitt, L. and Ferguson, S. L. (2024) 'Unlocking student creativity with Lego® serious play: a case study from the graduate marketing classroom', *Marketing Education Review*, 34(2), pp. 153 – 163. DOI: <https://doi.org/10.1080/10528008.2024.2337926>
- Gardiner, P. (2020), 'Learning to think together: Creativity, interdisciplinary collaboration and epistemic control', *Thinking Skills and Creativity Journal*, 38, pp. 100749 – 1 – 10
- Geitz, G. and Geus, J. D. (2019) 'Design-based education, sustainable teaching, and learning', *Cogent Education*, 6:1, 1647919, DOI: 10.1080/2331186X.2019.1647919
- Goldring, T., Harper, E., Jassal, R., Joseph, L., Kelly, A., Mulrooney, H., Piper, I. and Walker, H. (2018) 'Experience and expectations of transition to higher education: a qualitative exploration', *New Directions in the Teaching of Physical Sciences*, 13(1). Available at: <https://doi.org/10.29311/ndtps.v0i13.2849> (Accessed: 20 March 2025).
- He, S., Shi, X., Choi, T. and Zhai, J. (2023) 'How do students' roles in collaborative learning affect collaborative problem-solving competency? A systematic review of research', *Thinking Skills and Creativity Journal*, 50, pp. 10143 - 1-15. DOI: <https://doi.org/10.1016/j.tsc.2023.101423>
- Hernick, J. and Jaworska, E. (2018) 'The effects of enjoyment on learning', *Proceedings of INTED2018 Conference 5th-7th March 2018, Valencia, Spain*. Available at: 978 -84-697-9480-7. (Accessed: 3 June 2024)

Hussain, S., Lindh, J. and Shukur, G. (2006) 'Training on pupils' school performance in mathematics, problem solving ability and attitude: Swedish data', *Educational Technology & Society*, 9 (3), pp. 182 -194

James, A. (2013) 'Lego Serious Play: a three-dimensional approach to learning development', *Journal of Learning Development in Higher Education*, 6, pp. 2-18.

Joordens, M., Chandrasekaran, S., Stojcevski, C. and Littlefair, G. (2012). 'The process of design based learning: a students' perspective', *Profession of Engineering Education: Advancing Teaching, Research and Careers: 23rd Annual Conference of the Australasian Association for Engineering Education*

Juvonen, J., Espinoza, G., Knifsend, C. (2012). 'The Role of Peer Relationships in Student Academic and Extracurricular Engagement', In: *Handbook of Research on Student Engagement*. Springer, Boston, MA.

Li, Y., Huang, Z., Jiang, M., & Chang, T. W. (2016) 'The Effect on Pupils' Science Performance and Problem-Solving Ability through Lego: An Engineering Design-based Modeling Approach', *Educational Technology & Society*, 19 (3), pp. 143–156.

Lindsay, S., Hounsell, K. G. and Cassiani, C. (2017) 'A scoping review of the role of Lego therapy for improving inclusion and social skills among children and youth with autism', *Disability and Health Journal*, 10(2), pp. 173–182. DOI: 10.1016/j.dhjo.2016.10.010 (Accessed: 3 June 2024)

Lugaresi, G. Frigerio, N. and Matta, A. (2020) 'A new learning factory experience exploiting Lego for Teaching Manufacturing Systems Integration', *Procedia Manufacturing* 10th Conference on Learning Factories, 45, pp. 271 – 276

McMillan, W. (2013) 'Transition to university: the role played by emotion', *European Journal of Dental Education*, 7(3), pp. 169 – 176.

Oo, T. Z., Kadyirov, T., Kadjrova, L. and Józsa, K. (2024) 'Design-based learning in higher education: Its effects on students' motivation, creativity and design skills', *Thinking Skills and Creativity Journal*, 53, pp. 101621 – 1- 15. DOI: <https://doi.org/10.1016/j.tsc.2024.101621>.

Özgün-Koca, S. A, Edwards, T. G and Chelst, K. R. (2015) 'Linking Lego and Algebra', *National Council of Teachers of Mathematics*, 20, pp. 400 – 407

Pietarinen, J., Soini, T. and Pyhältö, K. (2014). 'Students' emotional and cognitive engagement as the determinants of well-being and achievement in school', *International Journal of Education Research*, 67, pp. 40-51. DOI: <https://doi.org/10.1016/j.ijer.2014.05.001>

Prananto, K., Cahyadi, S., Lubis, F. Y. and Hinduan, Z. R. (2025) 'Perceived teacher support and student engagement among higher education students – a systematic literature review', *BMC Psychology*, 13(112). Available at: <https://doi.org/10.1186/s40359-025-02412-w> (Accessed: 20 March 2025).

Quin, D. (2017) 'Longitudinal and contextual associations between teacher–student relationships and student engagement: A systematic review', *Review of Educational Research*, 87(2), pp. 345 – 387.

- Rivera, E. S. and Garden, C. L. P. (2021) 'Gamification for student engagement: a framework', *Journal of Further and Higher Education*, 45 (7), pp. 999 – 1012. DOI: <https://doi.org/10.1080/0309877X.2021.1875201>
- Schimpf, C. (2021) 'Engineering in Videogames: A case study of Iconoclasts narrative and interactive portrayal of engineers', *American Society for Engineering Education Annual*. DOI:10.18260/1-2--37065
- Sharma, B. U. (2024) 'Impact of Universal Design for Learning (UDL) on Student Engagement and Achievement in Inclusive Education', *International Journal of Novel Research and Development (IJNRD)*, 9(8), pp. 173 – 176.
- Souza, I., Andrade, W.L., Sampaio, L. M. R., Oliveira, A. L. S. and Araujo, S. O. (2018) ' A systematic review on the use of Lego Robotics in Education'. *2018 IEEE Frontiers in Education Conference (FIE)*, pp. 1-9, DOI: 10.1109/FIE.2018.8658751
- Walton, G. M. and Cohen, G. L. (2011) 'A brief social-belonging intervention improves academic and health outcomes of minority students', *Science*, 331(6023), pp. 1447–1451. DOI: 10.1126/science.1198364
- Wheeler, A. (2023) 'Lego® Serious Play® and higher education: encouraging creative learning in the academic library', *Insights the UKSG Journal*, 36(8), pp. 1–8. DOI: <https://doi.org/10.1629/uksg.611>