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PedaLEGOgy – Using LEGO® crime scenes as an inclusive way to 'build' student learning, engagement and educational experience in forensic science

Title: PedaLEGOgy - Using LEGO® crime scenes as an inclusive way to 'build' student learning, engagement and educational experience in forensic science.

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Abstract:

Since Francis Glessner Lee created the Nutshell Studies of Unexplained Death in the 1940s, the use of miniature crime scene representations has become an accepted and reliable method of allowing students and practitioners to explore, interact, and learn from representations of crime scenes without risk of contamination. Although Lee's dioramas are still utilised in teaching and training within the forensic sciences these realistic models are expensive and time consuming to create. This research explores an alternative approach to creating miniature crime scenes through the use of Lego® in a workshop developed primarily for undergraduate students. The workshop was developed to align with the Chartered Society of Forensic Sciences CSI Component Standard Matrix and can be easily altered, augmented and re-set to generate new crime scenes to explore different case contexts. The workshop compared two activities: 1) a 30-minute Lego® model activity, and 2) a 30-minute paper-based (non-Lego®) descriptive activity. Questionnaire data collected from 76 students explored demographics, prior experience of Lego® and their engagement in each of the two activities (Lego® verses descriptive). Both activities included the same prompts to discuss CSI team roles, methods for recovery and documentation of different evidence types, and to highlight which evidence items should be prioritised. Questionnaire responses were captured following each activity for a series of seven-point Likert scale questions. While student responses to both activities were generally positive, significantly higher engagement was demonstrated for all measurements when an explorable Lego® model was used compared with descriptive methods. Students commented that the Lego® model activity was fun, interesting and engaging, and made them feel more prepared for their physical crime scene examination assessment work. It was also noted that the Lego® crime scene was inclusive across cohort, sex and disability.

Key words:

Crime Scene Investigation; Pedagogy; Engagement; Lego®; Inclusive; Sustainable; Education; Forensic Science.

Introduction:

The use of representations of crime scenes is a long-established aspect of teaching forensic science. The concept stems back to the 1940s with Francis Glessner Lee introducing dioramas as a means of training police investigators in crime scene detection skills [1]. Modern teaching of the subject often uses indoor crime scene rooms or outdoor settings with simulated scenarios that can allow students to apply their knowledge while developing their critical thinking and collaborative skills [2].

One potential issue with developing sustainable simulated crime scenes is that it can require significant planning, time and purchasing of bespoke materials [2], as well being costly, for both space and staff, and potentially limiting the number of students who can access the space at any one time. A number of researchers have explored more sustainable practices to physical simulated scenes including the use of virtual reality (VR) [3, 4], tours of forensic laboratories [5], use of an interactive cube environment [6], google earth [7] and augmented reality (AR) [8]. Each of these techniques has its successes but also limitations, for example, using VR headsets has been found to cause motion sickness in some individuals [3] limiting how inclusive the activity is, while tours to forensic laboratories can falter if the professionals working within the laboratories are too busy to facilitate, feel uncomfortable with students being present and potentially pose a risk to confidentiality [5]. Even when there are sufficient crime scene houses available, access tends to be shared with other groups and using these facilities for practice is difficult as it is both resource and time intensive. For this reason, classroom-based activities are often developed and delivered in lieu of or as preparation for assessment at a physical crime scene. This research explores a further alternative through using Lego® as a means to create the simulated crime scene.

Lego® was created in 1934 with the word "Lego" derived from the Danish phrase "leg godt," which translates to "play well" in English. Lego® has long been used in research settings with example applications including programming [9], therapeutics [10], pedagogic interventions [11], creativity [12], business studies [13], and robotics [14]. Lego® Serious Play, developed as a team management tool [15], has also been utilised for reflective purposes in Higher Education such as exploring international student transition [16], supporting library workshops [17] and perceptions of assessment feedback [18]. There has also been some use of Lego® bricks to model key concepts in chemistry [19], biochemistry [20], immunology [21] and optometry [22]. These examples fit neatly into pedagogic approaches such as playful learning, which can stimulate intrinsic motivation and educational drive in both staff and students [23], and is practiced by using tools (e.g. games, toys, puzzles), techniques (e.g. role play, making/crafting, problem solving), and specific tactics (e.g. surprise, storytelling, mystery) [24]. Themes emerging from playful learning studies suggest that play cultivates a good classroom

environment, removes barriers to learning and supports enhanced learning [25]. Given that an estimated 5% of all Lego® purchases are made by (and for) adults [26] it is perhaps surprising that this accessible and adaptable resource that fits neatly into defined pedagogic practices, has not been used more widely in Higher Education generally, and especially in forensic science. There are good examples of public outreach by scientific teams using Lego® to help communicate their research to a wider audience including the provision of Lego® resources for teaching physics [27], raising awareness of biofilms [28], and explaining the principles of DNA sequencing [29]. Whilst the research presented in this paper focuses on the use of Lego® models on a HEI forensic science programme, additional public outreach resources aimed at KS3/4 students were also developed and have been delivered in schools and at the Edinburgh Science Festival, 2025 [30]. These resources include a crime scene scenario as exemplified in this research (Supplemental material 1) but also use Lego® to explore concepts in cell biology, mixed source samples, and DNA profiling (Supplemental material 2 and 3).

Despite Lego® being used extensively in an educational context, use within a forensic science programme has not been explored previously to our knowledge despite Lego® creating the perfect opportunity for creating miniature crime scenes very much in the essence of Francis Glessner Lee's dioramas. This study assesses the pedagogic use of commercial Lego® sets prepared as crime scenes and presented to level 4 and level 5 undergraduate students on an undergraduate University Forensic Science Programme in a workshop setting alongside a more traditional descriptive activity.

Methods:

Activity Development

Two cohorts of full-time, UK-based undergraduate students on an undergraduate Forensic Science programme at University were invited to take part in the research, resulting in 32 level 4 students and 44 level 5 students. Participants were put into small groups of 4-6 people and were presented with two different activities to work through sequentially. The **Lego® model activity** was a prepared Lego® crime scene with an activity brief and prompts to support interactive discussion. Five different Lego® sets (Cat Nos: 10297 Boutique Hotel, 10312 Jazz Club, 10326 Natural History Museum, 21330 Home Alone House, 76269 Avengers Tower) were modified to create five different crime scenes (1a, 1b, 1c, 1d, 1e), each comprising a multi-story building, with entrances and exits, individual locations/floors, and fully furnished individual rooms (Figure 1). Lego® evidence selected for the model crime scenes were based on similar items used in real crime scene houses for student assessments. In the majority of instances these were provided within the Lego® kit contents. Additional items were purchased from

the Lego® Pick a Brick webpage. Marks and traces were applied using paints and included footwear traces to determine suspect pathways, blood/fluid traces on surfaces, and blood patterns mimicking spatter. Evidence of physical entry and/or struggle included open/broken windows and doors, knocked over tables and lamps, and missing/stolen/hidden items. Physical evidence included weapons (firearms, knives, bats), crowbars, drinking vessels, electronic devices (phones, keypads, laptops), poisoned animals, chemical containers, and non-evidentiary household items. Deceased individuals, witnesses and suspects were also present on the scene. The **Descriptive activity** was a written description of a Lego® crime scene house, including exterior environment, interior layout, and details of associated evidence, with an activity brief and discussion prompts. Five different written descriptions were prepared, each based on one of the different Lego® crime scenes (2a, 2b, 2c, 2d, 2e) with an example provided in Supplemental material 4.

Pedagogic Basis

Both Lego® and Descriptive activities were developed to allow small group discussion of key CSI principles taught within the wider study module. As such this student-led workshop required reflection, discussion and artifical application of taught concepts linked to the module Learning Outcomes (LOs). For level 4 students, the module LOs focussed on the identification and evaluation of different types of physical evidence and understanding principles and methods of crime scene investigation. For level 5 students, the module LOs focussed on the critical evaluation of crime scene investigation methods and understanding evidential versus intelligence values. To further strengthen the pedagogic basis of this intervention the workshop was linked to the Chartered Society of Forensic Sciences (CSoFS) Component Standard Matrix for Crime Scene Investigation (2022 v3), a requirement for university course accreditation. Specifically; Component 1 (Scene Stabilisation & Strategy Setting) where learners are expected to a) Demonstrate an understanding and describe the roles, responsibilities and liabilities of all personnel involved in the processing of crime scenes, b) Demonstrate an understanding and describe the roles of specialists who may attend crime scenes for scene stabilisation, evidence recording and/or recovery, c) Understand and communicate priority sequence of evidence recovery and examination at the scene; Component 2 (Preservation, Search & Collection of Evidence) where learners are expected to a) understand and demonstrate the steps required for the preservation and documentation of the crime scene, b) Understand and demonstrate the steps required for the systematic search and recovery of evidence, c) Understand and demonstrate the steps required for the collection of all evidence types, and Component 9 (Safe Working Practices)

where learners are expected to describe and demonstrate adherence to safe working procedures at the crime scene.

Figure 1. *Lego® set 10297 Boutique Hotel. External to the hotel there is an alleyway with dumpster bin (A), and an annexed art gallery (B). Three floors allow crime scene investigation across multiple rooms and onto the street for egress and exit discussions (C). Fully furnished rooms allow mock evidence to be placed and traces left (D) allowing for creation of mock crime scene (E). All chosen Lego® models were similarly explorable.*

Data Collection and Analysis

Students first formed groups of 3-5 around small tables, before being briefed on the nature of the activity they were about the participate in. Demographic and experiential background questions (Questions 1-9) were completed at the start of the workshop prior to commencing the activity. Once

settled, they were encouraged to read and discuss the crime scene briefing before following any activity prompts (example handbook provided in Supplemental material 4). Rather than provide specific scene processing instructions, prompts were included in the handbook to aid discussion of scene processing, health and safety, evidence prioritisation, and packaging requirements. For the Lego® Activity these prompts necessitated physical manipulation of the model and a visual examination of the scene. For the Descriptive Activity, the same prompts required groups to read associated text to identify any salient details prior to group discussion. At the end of each activity (Lego® or Descriptive) students were asked to complete a further questionnaire containing a mix of Likert scale and open response questions that explored participants engagement (Questions 10-12) and their thoughts on how well the activities helped them think about and discuss key crime scene principles linked to Component Standard Matrix for Crime Scene Investigation as described above (Questions 13-19). Open field responses (Questions 20-23) explored aspects of inclusivity. Questions are detailed in Table 1). Participants returned their completed questionnaires for both activities at the end of the workshop. To minimise experimental bias, the order of the two activities was reversed for half of each cohort with students not seeing the proceeding activity before the first activity was completed (mimicking sequential unmasking). To minimise a learner effect, different crime scene scenarios were used for the sequential activities, i.e. Lego® activity 1a was paired with descriptive activity 2b (as shown in Supplemental material 4). To avoid confirmation bias, discussion around expected results and analysis were avoided. The potential for supervisory bias where the student responds positively to what they think their supervisor believes was minimised via collection of the data by two level 6 students.

Data were input into excel spreadsheets and were analysed using SPSS v29. Demographic and experiential data were captured as simple counts while Likert Scale responses were coded from -3 (most negative) to 0 (neutral) to 3 (most positive). Coded Likert Scale responses were analysed using the Related-Samples Wilcoxon Signed Rank Test to assess differences in scores between the Lego® and Descriptive activities. The change in Likert Scale score between the Lego® and Descriptive activity was calculated for paired responses and analysed using the Mann Whitney U Test to explore differences between demographic groups (level, sex, disability). Effect sizes were calculated for Mann Whitney U Test ($r = z / \sqrt{N}$ where N is the total number of cases) and Wilcoxon Signed Rank Test ($r = z / \sqrt{(2N)}$ where N is the total number of paired observations), and assessed using Cohens criteria of small effect (r = 0.1), medium effect (0.3) and large effect (0.5) [31]. Three-word student feedback comments were analysed by determining the frequency of use for different words, with short descriptive phrases considered a single term (e.g. too hard). Similar terms were grouped into categories (e.g. visualise/visualisation). The frequency of use was compared between the Lego® and Descriptive

activities and a word cloud produced for each activity [32]. Additional open response student feedback comments were also considered.

Table 1. *Questions asked, data type captured, response rate and context.*

Question No:	Question	Data Captured	Response Rate	Context
1	Age	Open Field	97%	Demographics and Inclusivity
2	Sex (at birth)	(Male), (Female)	97%	
3	Gender	(Cis-Woman), (Cis-Man), (Trans-Woman), (Trans-Man), (Non-binary), (Prefer not to say)	97%	
4	Ethnicity	(White or White British), (Asian or Asian British), (Black, Black British, Caribbean, African), (Mixed or multiple ethnic groups), (other ethnic group)	96%	
5	Disability	(Yes), (No), (More information)	97%	
6	I engage in group activities	Likert Scale 1-7	97%	Prior Personal Experience
7	I am interested in Crime Scene Investigation topics	Likert Scale 1-7	97%	
8	I had Lego sets as a child and/or I have Lego sets and/or my child has Lego sets	(Yes), (No)	97%	
9	I enjoy Lego	Likert Scale 1-7	97%	
10	How much did you enjoy the activity?	Likert Scale 1-7	100%	Learner Engagement
11	How interested were you through the activity?	Likert Scale 1-7	100%	
12	Did individuals in your group contribute equally?	Likert Scale 1-7	100%	
13	How much did the activity reinforce some of the taught CSI components on your course?	Likert Scale 1-7	99%	Applicability of content to existing module concepts, assessments and CSoFS CSI Matrix Components
14	Do you think an activity such as this would help students prepare for their crime scene assessment?	Likert Scale 1-7	100%	
15	How well did the activity help you think about the stabilisation and prioritisation of evidence?	Likert Scale 1-7	100%	
16	How well did the activity help you think about how you would collect different forms of evidence?	Likert Scale 1-7	99%	
17	How well did the activity help you think about anti-contamination practices?	Likert Scale 1-7	100%	
18	How well did the activity help you think about sample packaging?	Likert Scale 1-7	100%	
19	How well did the activity help you think about crime scene health and safety?	Likert Scale 1-7	100%	
20	In three words, please tell us what you thought about the activity?	Open Field	88%	Inclusivity
21	Any other comments?	Open Field	54%	
22	Which of the two activities did you prefer?	(Lego), (Descriptive)	100%	

Results and Discussion:

The response rate for each field of the questionnaire was consistently high (≥96%) except for questions 20 and 21 which had a response rate of 88% and 54% respectively. As these were open response student feedback questions it is possible that respondents felt these were optional, although the high response rate overall suggests the questionnaire was effective and the resulting data was robust in terms of n number.

<u>Demographics and Prior Experience</u>

Demographic data shows the combined cohorts of level 4 (n=32) and level 5 (n=44) had a span of ages from 18 - 25 years, with the majority being between 18-21 (93%), and a higher proportion of female

(68%) to male (28%) students. All individuals reporting their sex at birth also reported as being Cis-Gender. The skew in favour of female students on the Forensic Science programme is mirrored across Higher Educational Institutes and is generally acknowledged in the field [33, 34]. The majority of the participants identified as White British (87%), with other ethnicities comprising 9% of the cohort, suggesting a similar ethnic composition compared to the total population of England and Wales based on the 2021 Census [35]. Eleven individuals (15%) identified as having a learning disability (Autism, ADHD or dyslexia, singly or in combination), with another two individuals having a physical disability, generally lower than observed in the total population of England and Wales [36].

Prior personal experience suggests an engaged cohort with 81% of learners agreeing that they engage in group activities, and 97% having an interest in crime scene examination topics. 86% of respondents reported some experience of Lego® sets, either when growing up, currently, or with their own children, with 82% agreeing that Lego® was enjoyable, and only 4% disagreeing with the idea of enjoying Lego®. Such high levels of prior experience are not surprising given that Lego® was listed as one of the most 100 influential companies in 2025 [37] with 70 billion Lego® elements sold each year across 130 countries [38]. Such positive prior experience data will likely bias response data but also suggests the inclusion of Lego® in a taught crime scene setting could be positively received generally.

Lego® vs Descriptive Activity - Engagement

Student engagement consistently increased when using the Lego® crime scene models, with the student poll at the end of the workshop finding that all students preferred the Lego® activity more than the Descriptive activity. A significant improvement in Likert scores was found with the Lego® activity for enjoyment ($Z = -6.182$, $P < 0.001$) and interest during the activity ($Z = -6.431$, $P < 0.001$) with a large effect size for both ($r = 0.5$ and $r = 0.52$ respectively). This is highlighted by the clustering of responses in the right-hand quadrants of the bubble plots (Figure 2A and 2B). The proportion of positive Likert responses more than doubled for enjoyment from 40% (Descriptive) to 88% (Lego®), and for interest from 47% (Descriptive) to 92% (Lego®). A corresponding large decrease in negative responses for the Lego® activity was also observed for both enjoyment (from 30% to 3%) and interest (from 29% to 1%). Group participation was generally rated positively for both activities, responses clustering in the top right quadrant of the bubble plot (Figure 2C), but a significant increase was found when using the Lego® models ($Z = -4.094$, $P <0.001$) with a medium effect size ($r = 0.33$). The proportion of positive scores for group participation increased from 74% (Descriptive) to 92% (Lego®).

Students noted significantly increased enjoyment and interest in the Lego® model activity compared to the descriptive activity, possibly due to greater active engagement and practical relevance. Such observations have been made previously with students who completed a 'hands-on' task reporting increased motivation and participation [39, 40] while students using Lego® Serious Play sets display characteristics of enjoyment, such as smiles and laughter [41]. This could imply that students enjoyed the Lego® activity more due to familiarity with Lego® and the association of it with having fun. The increase in group contribution within the Lego® also supports previous observations that hands-on activities foster group cooperation [42], although cooperation between participants was observed in both activities (Figure 2c).

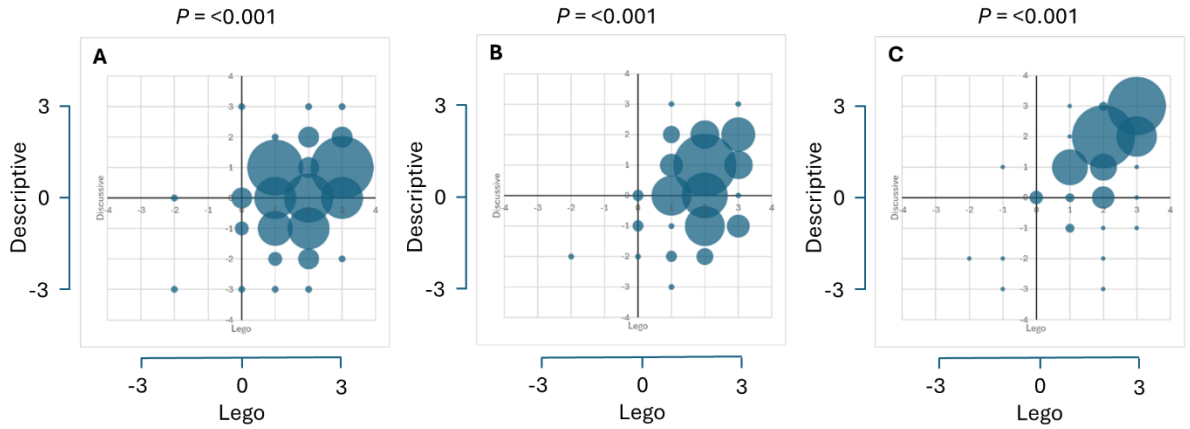

Figure 2. *Bubble plots showing paired response rates to questions (A) "How much did you enjoy the activity?"; (B) "How interested were you through the activity?"; and (C) "Did individuals in your group contribute equally?". -3 = most negative response, 0 = neutral response, 3 = most positive response. Size of bubble is scaled to the number of responses. Wilcoxon Signed Rank Test revealed significant differences (all P = <0.001) in response between the activities for all three questions with large (r ≥ 0.5, A and B) and medium (r = 0.33) effect sizes.*

Lego® vs Descriptive Activity - Applicability

Students were asked how much each activity reinforced the concepts covered in their taught crime scene module and whether they thought the activity would help them prepare for their crime scene assessment. Students felt both activities reinforced the concepts covered in their taught crime scene module. This was significantly higher for the Lego® activity (Z = -2.750, *P* = 0.006), with a small to medium effect size (r = 0.22), even though both were developed to reinforce the exact same elements.

Figure 3 shows the proportion of positive Likert responses increased from 71% (Descriptive) to 87% (Lego®), with a decrease in both neutral (from 17% to 8%) and negative (from 12% to 5%) scores. Students also reported that the Lego® activity was a better preparatory activity for their crime scene assessments than the descriptive activity (Z = -4.056, *P* = <0.001) with a medium effect size (r = 0.33). Positive scores increased by a third from 58% to 80%, and there was a substantial decrease in negative scores from 30% to 8%. While effect sizes were not large, this data supports the adoption of this activity over the existing descriptive activity currently used.

An important consideration in the design of these activities was that they not only support student 'engagement' but also student 'learning'. As such the briefing document for each activity included the same series of prompts for interactive discussion within the group, developed to align with aspects of the Chartered Society of Forensic Sciences (CSoFS) CSI Component Standard Matrix. The prompts link directly to taught components on level 4 and level 5 crime scene modules, with the spiral curriculum nature of the programme meaning more in-depth discussions can be had as students progress through the course. As with previous data, a significant shift towards more positive Likert responses occurred for the Lego® activity for all of the CSI matrix prompts (Figure 3, all *P* < 0.05) with small to medium effect sizes (r = 0.23 to r = 0.44). However, the effectiveness of the activities to support discussion varied depending on the CSI matrix aspects under consideration.

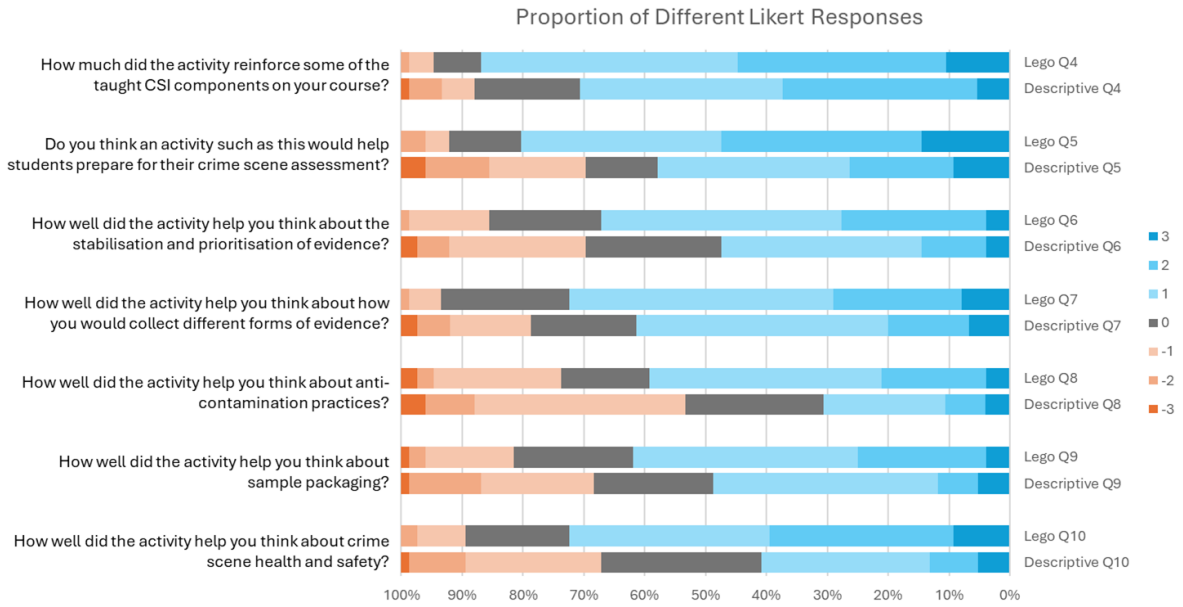

Figure 3. *Proportion of different Likert-scale responses for questions assessing alignment to existing module content and CSoFS CSI Component Standard Matrix. Orange indicates negative responses (-3 to -1), grey indicates neutral responses (0), blue indicates positive responses (1 to 3).*

Students felt that both activities provided the most support for thinking about how to collect different forms of evidence (positive scores: 72% Lego®, 61% Descriptive) while anti-contamination practices were least supported (positive scores: 59% Lego®, 31 % Descriptive). This indicates that further development of prompts and greater scaffolding of group discussion on specific aspects of the CSI matrix would be beneficial. Generally the results suggest that students are learning and engaging more effectively which is supported by previous studies that have shown interactive crime scene environments reinforce learning [43, 44]. One explanation for the significant difference may be the existence of physical evidential indicators in the Lego® activity, which act as visual prompts to discuss evidence recovery and prioritisation techniques. With crime scene investigation requiring a systematic methodology and physical search [45] the Lego® model gave the students the opportunity to manipulate the model, gaining a greater insight into what evidence could have been left and where it was located, potentially allowing for greater accuracy in crime scene reconstruction [46].

Lego® vs Descriptive Activity - Inclusivity

Questionnaire response data was then analysed for differences between demographic groups for level, sex, and disability, but not for ethnicity or gender due to low diversity and underrepresentation of different groups within the cohort. There was no significant difference between Level 4 and level 5 students in the change in Likert score between the two activities, with both groups showing a more positive response for the Lego® activity. Significantly more positive responses to the Lego® activity were observed for males and those with a disability for several applicability questions, with effect sizes that were small to medium. Both males ($U = 362.0$, $P = 0.022$, $r = 0.27$) and those with a disability ($U = 605.5$, $P = 0.002$, $r = 0.35$) felt the Lego® activity was more helpful in preparing for their crime scene assessment, and also in reinforcing taught CSI components for students with a disability ($U = 522.0$, $P = 0.017$, $r = 0.28$). The Lego® activity also showed a more positive increase in Likert score for how well male students felt it helped with considering stabilisation and prioritisation of evidence ($U = 351.5$, $P = 0.014$, $r = 0.29$) and anti-contamination practices ($U = 369.0$, $P = 0.032$, $r = 0.25$). This data suggests that the Lego® activity had a greater impact on CSI learning and was a more inclusive activity for these groups that make up a smaller proportion of the cohort (males = 28%, disabled = 17%), with the greatest impact on improving preparedness for the crime scene assessment for those with a disability. Differences in response for ethnicity or gender were not formally analysed due to low diversity and underrepresentation of different groups within the cohort.

When asked to provide three words to describe each of the activities there is again a clear indication for a Lego® crime scene preference (Figure 4). A greater number of responses were received for the Lego® activity (96% responses, 167 terms) than for the descriptive activity (88% responses, 131 terms), with a higher proportion of positive words (93% vs 58%) and a lower rate of negative words (5% vs 36%) used to describe the Lego® activity. The top four terms used to describe the Lego® activity were 'fun', 'interesting', 'engaging' and 'interactive', making up 51% of all the terms used, while for the descriptive activity the top category of term was 'too wordy'. Interestingly, the next most common terms were also 'fun', 'interesting', and 'engaging', but each occurred at a much higher frequency for the Lego® activity (11-17% vs 5%). The top four terms used for the descriptive activity made up 25% of all the terms used, with individuals using more varied vocabulary to describe this activity. The use of the three terms among those with a disability showed a higher importance of visualisation than for the cohort overall. The top three word categories for the Lego® activity were 'fun', 'interesting' and 'visual/visualisation', while there was a greater use of negative words for the descriptive activity with the top three being 'too wordy', 'confusing' and 'hard to visualise'. This suggests the Lego® activity is more inclusive among individuals with disability and supports the data showing a more positive response in terms of reinforcing taught concepts and preparedness for their crime scene assessment. Open response comments also provided support for greater inclusivity of the Lego® activity among this demographic as those with dyslexia noted that the descriptive activity was 'difficult for someone that has a learning disability' and 'difficult to visualise scene, evidence etc. Difficult to retain information from paragraph to paragraph'. The Lego® activity helped with visualisation 'This activity really helped me to visualise the scene and see where things were' and facilitated group work more as 'each person will perceive the crime scene from text differently but this way everyone is on the same page'.

Across the wider cohort the open response comments (Supplemental material 5) mirrored the three-word responses for greater fun, engagement and enjoyment with the Lego® activity and highlighted the benefits of better visualisation both for group work and for applying crime scene knowledge in a workshop setting. Furthermore, all students (100%, n=76) voted that the Lego® crime scene was their preferred activity, reinforcing the statistically significant results in favour of Lego® observed throughout the experiment.

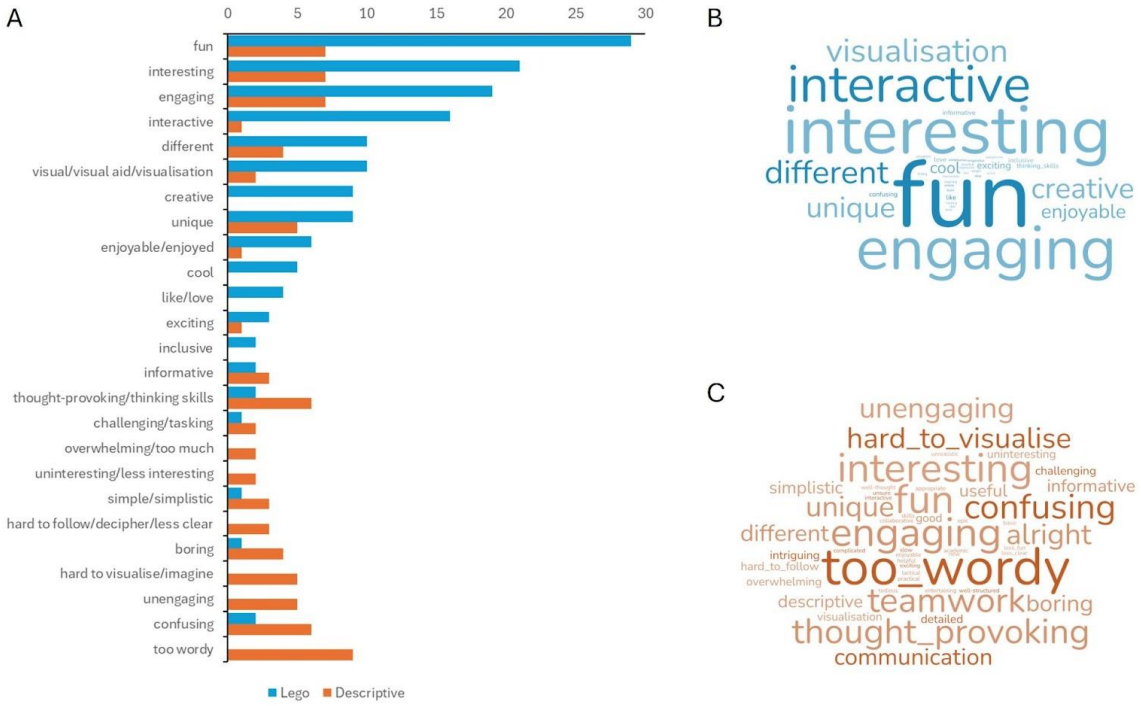

Figure 4. *Student feedback when asked "In three words tell us what you thought about the activity". (A) Frequency of use for categories of words chosen at least 3 different times for either activity (Blue bars = Lego® Activity, Orange bars = Descriptive Activity). Words clouds generated using frequency data for all categories of words chosen for (B) Lego® activity and (C) Descriptive activity.*

Despite such overall positive data, limitations to the intervention need to be highlighted and include the cost of purchasing Lego (~£1000 for this study), lack of realism, the small scale of the models, and the associated impact on viable group size. It should also be noted that while playful learning has potential in all education systems, different cultures can have different perceptions of playful approaches or may encounter issues relating to accessibility or costs when it comes to Lego® as a resource. That said, collectively these data highlight the benefits of using a model when training students in tasks that require the use of visual skills in a real setting, as found for other methods of simulating crime scenes including computer-based [47], virtual reality [3] and augmented reality [8]. Further work will consider development of the Lego® model workshop to provide greater scaffolding of discussion tasks and prompts, and the introduction of a Lego® model crime scene scenario development task to foster greater creativity, group work and deeper conceptual understanding [48]. Such physical models could also be used as a tool in embedding a case-based scenario through guided-inquiry to increase engagement in areas across the wider curriculum [49].

Summary:

This research demonstrates how forensic teaching concepts first introduced over 80 years ago can be updated and made more accessible to a modern audience, whilst still addressing key learning criteria. The comparative study highlights the use of Lego® as a medium to create physical crime scene models that that are adaptable, accessible and relatively low cost, and promote engagement, group participation and inclusivity. The interlocking plastic building blocks of Lego® allow for a wide variety of potential crime scenes to be created, ease of use within the classroom due to their robust nature, and offer a sustainable approach when physical crime scenes are unavailable. Furthermore, our wider outreach and engagement efforts demonstrate that the same physical resources can be utilised for multiple different educational groups from KS3 onwards, with the only variation being the accompanying written material. Collectively these resources highlight some of the potential ways that Lego® can be used to augment teaching activities for forensic science. We have included a set of instructions (Supplemental material 6) and parts list for online ordering (Supplemental material 7) for those wishing to promote forensic science to schools in their local areas. Play well.

References:

[1] Bouchard, G., 2019. Murder in miniature. Performance Research, 24(5), pp.93-100.

[2] Bracewell, T.E. and Jones, C., 2022. The use of simulated crime scenes in teaching undergraduate forensic sciences: Implementing an active learning approach to forensics. Science & Justice, 62(6), pp.758-767.

[3] Mayne, R. and Green, H., 2020. Virtual reality for teaching and learning in crime scene investigation. Science & Justice, 60(5), pp.466-472.

[4] Khalilia, W.M., Gombár, M., Palková, Z., Palko, M., Valiček, J. and Harničárová, M., 2022. Using virtual reality as support to the learning process of forensic scenarios. IEEE Access, 10, pp.83297-83310.

[5] Lacks, R.D., 2007. The “real” CSI: Designing and teaching a violent crime scene class in an undergraduate setting. Journal of Criminal Justice Education, 18(2), pp.311-321.

[6] Nichols-Drew, L., 2018. The cube: an immersive blood pattern analysis experience. EAFS 2018 Triennial Conference, Lyon, France, 27-31 August.

[7] Davidson, K., 2021. Google Earth as a resource for remote teaching: an application to crime scene investigation. Journal of Learning Development in Higher Education, (22).

[8] Wilkins, H.V., Spikmans, V., Ebeyan, R. and Riley, B., 2024. Application of augmented reality for crime scene investigation training and education. Science & Justice, 64(3), pp.289-296.

[9] Klassner, F. and Anderson, S.D., 2003. Lego MindStorms: Not just for K-12 anymore. IEEE robotics & automation magazine, 10(2), pp.12-18.

[10] LeGoff, D.B., 2004. Use of LEGO© as a therapeutic medium for improving social competence. Journal of autism and developmental disorders, 34, pp.557-571.

[11] Lindh, J. and Holgersson, T., 2007. Does lego training stimulate pupils' ability to solve logical problems?. Computers & education, 49(4), pp.1097-1111.

[12] Gauntlett, D., 2014. The LEGO System as a tool for thinking, creativity, and changing the world. In Lego studies (pp. 189-205). Routledge.

[13] Kristiansen, P. and Rasmussen, R., 2014. Building a better business using the Lego serious play method. John Wiley & Sons.

[14] Souza, I.M., Andrade, W.L., Sampaio, L.M. and Araujo, A.L.S.O., 2018. October. A Systematic Review on the use of LEGO® Robotics in Education. In 2018 IEEE frontiers in education conference (FIE) (pp. 1-9). IEEE.

[15] Roos, J. and Victor, B., 2018. How it all began: the origins of LEGO® Serious Play®. International Journal of Management and Applied Research, 5(4), pp.326-343.

[16] Ajibade, B.O. and Hayes, C., 2020. An insight into utilising LEGO® Serious Play® to explore international student transitions into a UK higher education institution. London: SAGE Publications Ltd.

[17] Wheeler, A., 2020 'Using Lego® Serious Play® in Higher Education with Law Students: Encouraging Playfulness and Creativity within Library Workshops', Legal information management, 20(4), pp. 222–226.

[18] Ajibade, B. and Hayes, C., 2024 'An interpretive phenomenological analysis of nursing student perceptions of summative assessment feedback using LEGO® Serious Play', Higher education, skills and work-based learning, 14(2), pp. 329–351.

[19] Horikoshi, Ryo., 2021. "Teaching chemistry with LEGO® bricks" Chemistry Teacher International, vol. 3, no. 3, pp. 239-255.

[20] Austin S, Millar C, Christmas S, 2022. Case study: Perspectives on the use of LEGO® bricks in the biochemistry classroom. Essays Biochem 66 (1): 53–63.

[21] Bohlson, S.S., Baty, J.J., Greenlee-Wacker, M.C. and Bruns, H.A., 2022. Piecing complement together with LEGO bricks: impacts on interest, confidence, and learning in the immunology classroom. Immunohorizons, 6(7), pp.488-496.

[22] Gridley, A., 2018. "Building LEGO® Models To Teach Three Dimensional, Mechanical Concepts In Optometry", International Journal of Management and Applied Research, Vol. 5, No. 4, pp. 238-244.

[23] Nørgård, R.T., Toft-Nielsen, C. and Whitton, N., 2017. Playful learning in higher education: developing a signature pedagogy. International Journal of Play, 6(3), pp.272-282.

[24] Whitton, N.J., 2018. Playful learning: Tools, techniques, and tactics. Research in learning technology, 26, pp.1-12.

[25] Forbes, L.K., 2021. The Process of Play in Learning in Higher Education: A Phenomenological Study. Journal of Teaching and Learning, 15(1), pp.57-73.

[26] Bartneck, C. and Moltchanova, E., 2018. LEGO products have become more complex. PloS one, 13(1), p.e0190651.

[27] Queen Mary University of London. Lego Physics - School of Physical and Chemical Sciences. Available at https://www.qmul.ac.uk/spcs/engage/outreach/in-school/physics-resources/lego-physics/. Accessed on 24.7.2025.

[28] National Biofilms Innovation Centre. The Importance of Biofilms - Public Engagement & Outreach. Available at https://biofilms.ac.uk/public-engagement-and-outreach/. Accessed on 24.7.2025.

[29] Brickopore. Available at https://brickopore.co.uk/. Accessed on 24.7. 2025.

[30] Edinburgh Science Festival - Solving a Crime Brick by Brick. Available at https://www.edinburghscience.co.uk/event/solving-a-crime-brick-by-brick/. Accessed on 24.7.2025.

[31] Pallant J (2010) SPSS Survival Manual: A step by step guide to data analysis using SPSS. 4th Ed. McGraw Hill.

[32] Create beautiful Word Clouds for free. Available at https://simplewordcloud.com/. Accessed on 24.7.2025.

[33] Houck, M.M., 2009. Is forensic science a gateway for women in science?. *Forensic Science Policy and Management*, *1*(1), pp.65-69.

[34] Barbaro, A., 2019. ‘Women in Forensics: An international overview Women in Forensics: An international overview’, Forensic science international. Synergy, 1, pp. 137–139.

[35] UK Government Census 2021. Population of England and Wales. Available at https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/national-and-regional-populations/population-of-england-and-wales/latest/. Accessed on 24.7.2025.

[36] UK disability statistics: Prevalence and life experiences. Available at https://commonslibrary.parliament.uk/research-briefings/cbp-9602/. Accessed on 24.7.2025.

[37] Time Magazine. The Lego Group. Available at https://time.com/collections/time100-companies-2025/7296204/lego-group/. Accessed on 24.7.2025.

[38] The LEGO Group A short presentation. Available at https://www.lego.com/cdn/cs/aboutus/assets/blt4ee78e0776fce92f/LEGO_Company_Profile.pdf. Accessed on 24.7.2025.

[39] Holstermann, N., Grube, D. and Bögeholz, S., 2010. Hands-on activities and their influence on students’ interest. Research in science education, 40, pp.743-757.

[40] Grandzol, C. and Wynn, P., 2011. Retention, Motivation, and Enjoyment: An Exploratory Evaluation of the Effectiveness of Hands-On Learning. Journal of the Academy of Business Education, 12.

[41] Bulmer, L., 2009. The use of lego® serious play in the engineering design classroom. Proceedings of the Canadian Engineering Education Association (CEEA).

[42] Satterthwait, D., 2010. Why are 'hands-on' science activities so effective for student learning?. Teaching Science: The Journal of the Australian Science Teachers Association, 56(2).

[43] Albeedan, M., Kolivanda, H. and Hammady, R., 2024. Designing and evaluation of a mixed reality system for crime scene investigation training: a hybrid approach. *Virtual Reality*, *28*(3), p.127.

[44] Ma, J., 2024. Smart Tech Meets Forensics: Enhancing Crime Scene Investigation with Digital Simulations. Forensic Science International, p.112296.

[45] Ghanem, M. and Sobh, Z.K., 2021. Crime Scene Searching: An Exploration of Forensic Evidence. Crime Scene Management within Forensic science, pp.37-50.

[46] de Leeuwe, R., 2017. The hiatus in crime scene documentation: Visualisation of the location of evidence. Journal of Forensic Radiology and Imaging, 8, pp.13-16.

[47] Kummer N, Delémont O, Voisard R, Weyermann C., 2022. The potential of digital technologies in problem-based forensic learning activities. Sci Justice. 62(6):740-748.

[48] Chasanidou, D., Raikou, N., 2024. LEGO® for Professional Development: A Systematic Literature Review. In: Fang, X. (eds) HCI in Games. HCII 2024. Lecture Notes in Computer Science, vol 14731. Springer, Cham.

[49] Cresswell S.L, and Loughlin W.A., 2017. A Case-Based Scenario with Interdisciplinary Guided-Inquiry in Chemistry and Biology: Experiences of First Year Forensic Science Students | Journal of Chemical Education. J. Chem. Educ. 94, 8, 1074–1082

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Conflict of interest statement:

There are no conflicts of interest.