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STUDYING THE EFFECTS OF A 'LEGO SERIOUS PLAY' INTERVENTION WITHIN STUDENT GROUP DESIGN

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ABSTRACT
This study aimed to investigate the effects of employing Lego Serious Play (LSP) as an intervention in student engineering design sessions. LSP intends to enhance group participation and cultivate a common understanding through the embodiment and explanation of ideas in Lego models. Therefore, an hour-long session was designed for testing with student groups; half an hour spent tackling a design question using the LSP method (Lego part) and the other half on a similar question using equivalent traditional design methods (in a Non-Lego part).
Six groups were tested in total, with three of those groups analysed in detail to compare the effects of LSP on group productivity and engagement. This was achieved through full transcription and coding using Interaction Dynamics Notation [10] as well as additional codes, from which the design outputs and codes were counted.
The observed effects of LSP were that it increased descriptive productivity, as suggested by the literature, at the expense of creative productivity. It was also seen that LSP increased humour in the distracted periods of the sessions. While these were preliminary results and further verification is needed, it was suggested that these effects could be due to the success of Lego for communicating concepts but also acting as a barrier to developing alternatives to such concepts. Hence, instead of producing as many ideas as in the Non Lego parts, in the Lego parts, participants instead tended to spend their efforts describing the existing concepts in creative and often humorous ways.

Keywords: Lego Serious Play, Student Group Design, Productivity, Social Engagement, Distraction, Humour

1 INTRODUCTION

Across education, productivity and engagement are both highly sought-after [2, 3, 4] and one approach which can help to achieve these is play [6, 7, 8, 9]. Hinthorne and Schneider [9] refer to play as "*active, performed, voluntary engagement in an activity"*, while serious play is *"goal-oriented and concerned with outcomes"* with a specified purpose beyond enjoyment. Serious play has become closely aligned with design and innovation activities in recent years [5]. It is also reported that play produces its benefits by facilitating experimentation and enjoyment [9]. In order to better understand the benefits of play within design education, this pilot study looked into the effects of Lego Serious Play as applied within university engineering design sessions.
Lego Serious Play (LSP) is one of several serious play tools/methods which has become well established in recent years. LSP a versatile communication tool developed by the Lego Group for use in group business planning meetings [8]. According to the existing literature, the benefits of Lego Serious Play stem primarily from the additional modes of communication that Lego provides to the group as they kinaesthetically, visually and verbally explain and develop their ideas with the rest of the group and to themselves [7, 8]. Through 'build', 'share', and 'reflect' steps, the group can work from a shared understanding leading to more effective ideas creation [7, 8, 9]. Furthermore, some authors have suggested that this format encourages participation regardless of social status, as ideas are embodied in Lego, separate from their creators [6, 8].
The purpose of the study was to evaluate the application of LSP within student group design, by investigating the productivity and engagement of several groups both with and without a unique Lego

intervention. From these observations, the proposed benefits of LSP, namely of improved understanding and participation, could then be assessed within the student group design context.

2 METHOD

2.1 Testing Method

In order to evaluate the benefits of LSP, a unique design intervention was developed for use in student group work based on the structure of LSP. Developed for use by student groups on their own design projects, each hour-long session would include two design questions; one answered using traditional design methods and the other answered with the inclusion of LSP. During the play-inclusive 'Lego' part of each session, the students would each describe the function or configuration of a sub-system by building a representative Lego model during the 'play period', whereas during the traditional 'Non-Lego' part, this would be achieved through discussion and other traditional design methods. Following each of these 'descriptions' sections, a 'problems' and 'solutions' section would follow, and each type of output would be written down for use beyond the session.

Six groups were tested in all, with the first, fifth and sixth groups being analysed in detail. These were selected as they comprised equivalent Lego and Non-Lego parts and were conducted within the same observation room. Test 1 focused on two separate user scenarios surrounding a visual aid for blind athletes. As this was an individual project, only one of the participants was fully familiar with the project, in contrast with the following tests. Test 5 concerned the manufacturing and operational costs of a wind turbine assembly machine, with the Lego part taking place before the Non-Lego part as an extra control measure to be compared with the other tests. Test 6 looked into concepts for laminating and packaging units for a bamboo processing machine.

2.2 Measurements and Metrics

Each test was video-recorded and Tests 1, 5 and 6 were fully transcribed before being coded for productivity and engagement. Productivity in this case was measured whenever an existing concept was first described in the conversation (descriptive output), or a new concept was introduced (creative output). This was done over the two modes of spoken and written outputs such that each idea was only counted once for each mode.

To code engagement, three modes were defined (cognitive, behavioural and affective) for both engagement and disengagement, which were identified from the interaction codes of Sonalkar's Interaction Dynamics Notation [10] and additional necessary codes. These codes, having been assigned to each spoken instance and action in the transcript, were then counted to give a numerical comparison for each type of engagement between the 'Lego' and 'Non-Lego' parts of each test.

For the purposes of this paper, all productivity counts have been considered. However, only two specific engagement codes have been considered to focus on the effects of LSP on social interaction within the groups. These are *distraction*, defined as "*an interaction (spoken or enacted) concerning a concept not relevant to the current subject and not resulting in a new output*", and *humour*, defined as "*an interaction responded to with laughter or further humour*" (based on IDN [10]). These were considered because they were the most recurring patterns between all groups in the Lego part. They investigate the role of LSP within distracted sequences, and the correlation between play and humour in these circumstances.

2.3 Analysis

To analyse the productivity of the groups over the three fully-investigated tests, counts for descriptive and creative, as well as spoken and written outputs were compared over the 'Lego' and 'Non-Lego' parts.

To analyse the social behaviour of the groups, a distracted sequence was specifically defined as "*a series of distracted group interactions, involving more than one participant, and containing more than one distraction instance.*" Using this, each test was filtered for such instances and the single-participant and single-instance distractions were discounted. The remaining distracted sequences were then analysed over the 'Lego' and 'Non-Lego' parts of each session to give a comparison of the nature of distraction with and without LSP.

3 RESULTS

3.1 Effects of LSP on Productivity

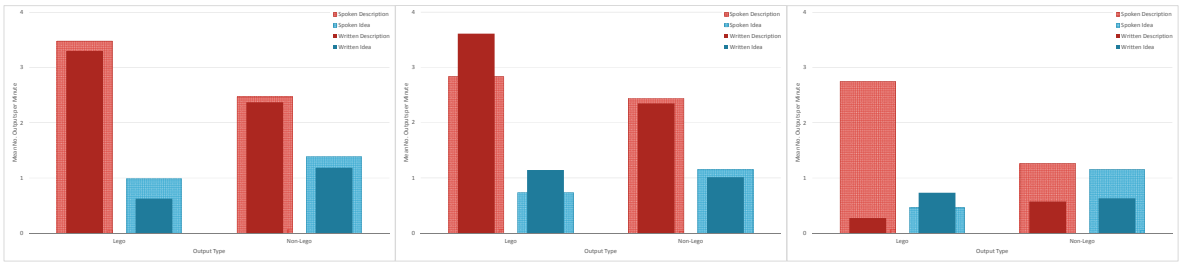


Figure 1. A comparison of productivity rates (No. of outputs per minute) over the Lego and Non-Lego parts of the sessions.

Figure 1 shows the productivity rates for Tests 1, 5 and 6 from left to right, respectively, with Test 1 scaled to give comparable rates for six equivalent participants (scaled from the actual four). The left two columns of each show the descriptive (red) and creative (blue) productivities over the 'Lego' part of the session; and the right columns the corresponding productivities for the 'Non-Lego' part. The significant trend over the three graphs is that the 'Lego' parts of all the sessions showed a greater focus on descriptive productivity at the expense of creative productivity, when compared to the 'Non-Lego' parts.

A finer detail which differentiates the three tests is the difference in written and spoken outputs of each type (darker compared to lighter bars). While in Test 1 there was more spoken productivity of each type than written, as the group discussed and wrote down ideas simultaneously, in the 'Lego' part of Test 5 there was greater written productivity as ideas were written down individually after the group discussion. However, the group of Test 6 were much more verbally productive as they looked into more conceptual design ideas. These observations are show the teams had sufficient freedom to run the session naturally according to their preference for their particular project.

3.2 Effects on Social Behaviour

To evaluate the effects of LSP on the social behaviour of the groups tested, the interaction codes for each participant over every section of the session were coded to give data such as that shown in **Figure** . This shows the modes of engagement for the group throughout Test 5 (each team member is represented in a separate colour), with the distracted sequences highlighted by the dark grey bars. From this, it can be noted that affective engagement in these periods, indicated by *humour* and *enjoyment*, often occurred in sequence with cognitive and behavioural disengagement, indicated by *distraction*.

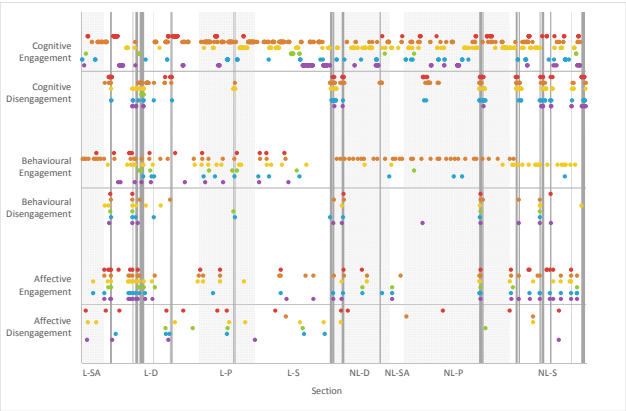
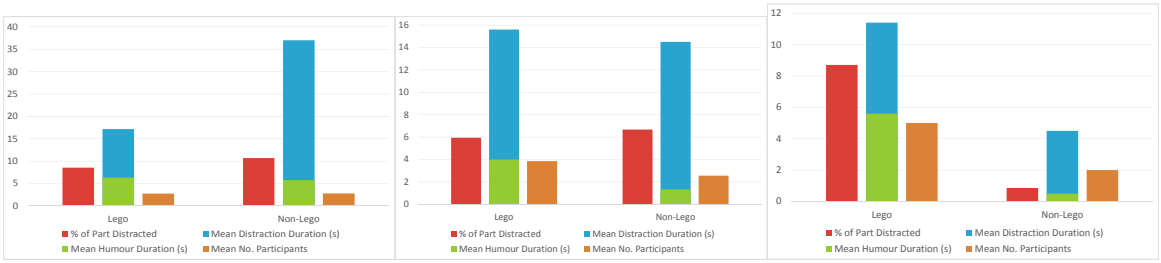


Figure 2. Notable periods of humorous distraction (Test 5) moving from the Lego part (L-SA to L-S) into the non-Lego part of the session (NL-D to NL-S)

Subsequently, using the data from the full series of distracted sequences from each test, discounting those triggered by external factors or which involved one member in isolation from the rest of the group, Figures 3, 4. and **5. Comparison of distraction sequences between Lego and Non-Lego**

parts of Test 1, 5 and 6, respectively show the overall amount of distraction for each part (red column in %), the mean distraction duration and duration of humour within that (blue and green in seconds), and the average number of participants involved in each distraction (orange). These are compared between Lego (left) and Non-Lego (right) parts.



Figures 3, 4. and 5. Comparison of distraction sequences between Lego and Non-Lego parts of Test 1, 5 and 6, respectively

Test 1

In Test 1, both parts consisted of the participants continually verbalising and then writing down outputs, such that conversation was kept up throughout the test. It follows then that the longest distractions in Test 1 were triggered when a participant took the conversation off on an unproductive tangent. This happened once in the Non-Lego part and twice in the Lego part, with the Non-Lego instance containing 8 seconds of humour within 102 seconds of distraction (8% humorous), compared to 33 seconds of humour in 62 seconds (53% humorous) in the two Lego instances.

The other significant source of distraction came from role-playing with the Lego. Following the play period, Participant D on three occasions played with the Lego minifigures jokingly as part of the conversation, generating 36 seconds of distraction and 21 seconds of humour (58% humorous).

Looking at the overall distraction for each part in **Figures 3**, more of the Non-Lego part was spent distracted, and the average distracted duration was over twice as long. This was largely influenced by the 102 second distracted conversation. In contrast, while the average humour duration per distraction was consistent over the two parts, the ratio of humorous to non-humorous distraction rose following the play period from 16% to 37%. It can also be seen that a similar average number of participants contributed to distraction over the session.

Test 5

Test 5 began with the Lego part followed by the Non-Lego part, and Participant A was initially reluctant to share his model, leading to the first distraction in **Error! Reference source not found.**. The remaining Lego distractions involved joking about certain occasions of breaking Lego models while attempting to demonstrate their functions or orientations. That is with the exception of the final Lego distraction of unproductive conversation once the group's ideas had run out.

The Non-Lego part of this test included similar distracted sequences, this time either caused by remarks on a participant's phrasing or commenting on a concept unproductively. A similar unproductive conversation was also observed to signal the end of productivity for this part.

Figures **3** and **4** shows a similar overall amount of distraction and average duration for each part. However, the average Lego distraction contained 26% humour compared to 9% for the average non-Lego distraction, and involved more people.

Test 6

Test 6 involved the group discussing their concepts, first written or drawn before being explained in the Non-Lego part, or built then explained in the Lego part. The Non-Lego part of this test contained only 9 seconds of distracted sequences including 1 second of humour. In comparison, the first ten seconds of distracted sequences following the play period contained 6 seconds of humour. This trend continued most notably when Participant B elaborated on the silly parts of his model for 36 seconds before briefly explaining the productive idea behind it. Overall, as shown in **Error! Reference source not found.**, this led to the Lego part containing 49% humour compared to the Non-Lego's 11%.

4 DISCUSSION

4.1 Effects of LSP on Productivity

The first effect of LSP shown in **Figure 1. A comparison of productivity rates (No. of outputs per minute) over the Lego and Non-Lego parts of the sessions.** is that it was seen to reduce creative productivity. That is, fewer new ideas were conceived using the Lego than in the control part of each test. This is most likely a side-effect of a greater focus in the Lego parts on describing concepts identified earlier in the project, before the session, than imagining new alternatives to such concepts, which also led to increased descriptive productivity with Lego than without. This in turn could be a direct influence of the descriptive focus required in building and explaining a concept through Lego, leading to the claim of Lego Serious Play that it enhances participants' collective understanding of the concept being described [6, 9]. Alternatively, this could be due to an unforeseen effect of the Non-Lego part structure in comparison with the Lego part structure; the most significant discrepancy being the play period of the Lego part lacking an equivalent individual concept definition stage in the Non-Lego part leading up to the group 'Descriptions' section.

To compare the benefits of increased descriptive productivity against the disadvantages of reduced creative productivity in this context, a future measurement of the effects of LSP on the *effective* productivity of design student groups – its role in identifying and defining the successful concepts used in the final project outcomes – is recommended for follow-up research.

4.2 Effects of LSP on Social Behaviour

Over the three tests, in both the Lego and Non-Lego parts, some more common sources of distraction were participants' comments relating to previous speech or actions. Many of these also included humour – responded to by other participants as such – or could be seen as attempts at humour which fell flat, although these could not be counted quantitatively. Similarly, there were several occasions of extended distracted conversation stemming from the productive conversation, providing a release of social tension built up during the group activity. With the exception of Test 1, these also signalled the end of productive activity as the productivity of groups ran dry.

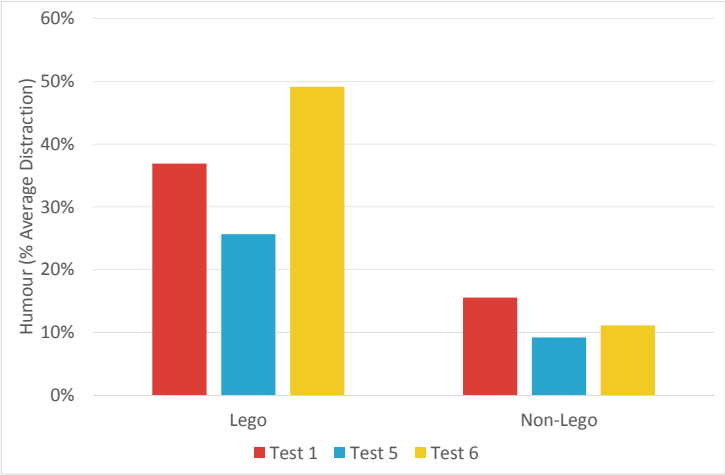


Figure 6. Comparison of the amount of humour within distracted sequences over the three analysed tests

Comparing the distracted periods of the Lego and non-Lego parts, **Figure 6**6 displays the average distracted humour ratios for each test (extracted from Figures 3, 4. and **5. Comparison of distraction sequences between Lego and Non-Lego parts of Test 1, 5 and 6, respectively**). This shows the Lego parts contained a significantly higher proportion of humorous distraction than the Non-Lego parts. This was seen both where the Lego part preceded the Non-Lego part (Test 5) and vice versa (Tests 1 and 6). This could be due to the direct influence of the individual play periods preceding the Lego parts, cultivating a playful attitude within the participants which was then expressed through more humorous side comments and anecdotes when compared to the Non-Lego parts. Additionally, this could be related to the reduced creative productivity in the Lego parts, whereby the creative effort

of the participants was spent on providing engaging, humorous ways to communicate their descriptive outputs instead of developing creative solutions to the problems at hand.
To better understand these results, further controlled tests must be conducted into their verification as well as, it is suggested, into the effects of the play period itself.

4.3 Limitations of the Study

Before discussing these results, it should be noted that this was a pilot study on the effects of LSP within student engineering design, so further evidence is needed to verify them. Hence the results may be used to fuel further research into this area, even if no solid conclusions can be claimed.
It should further be noted that the three tests from which the results were compiled consisted of different mechanical engineering student groups concerning different projects, looking into different aspects of such projects. This was a limitation of the resources available and it is recommended that more strictly controlled research be conducted across larger student samples.

5 CONCLUSION

From the three fully analysed tests conducted, three effects of LSP were observed, by comparing the Lego and Non-Lego parts of each test. Firstly and secondly, LSP was seen to increase descriptive productivity at the expense of creative productivity. It is not clear as to the effects of the structure of the conducted design sessions on these results (into which further work is recommended), but the focus on describing concepts through play to cultivate a common understanding amongst the group [6, 9] may have distracted from the overall objective of producing creative ideas. It is also suggested that the effectively and creativity of the ideas produced using LSP be investigated, for a wider view of the effects of LSP on productivity.
Thirdly, LSP was seen to increase humour in distraction. This could have been a direct effect of a playful attitude from the play period preceding the Lego parts, or a secondary effect of the descriptive focus of LSP in which creativity was expressed through humour in place of creative productivity. Again, further work is encouraged to verify and explore these results more deeply, and it is hoped this study will fuel interest in doing so.

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