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Exploring Cyber Security Awareness Through LEGO Serious Play Part I: The Learning Experience

Petra Maria Asprion
University of Applied Sciences Northwestern Switzerland, Switzerland
petra.asprion@fhnw.ch

Bettina Schneider
University of Applied Sciences Northwestern Switzerland, Switzerland
bettina.schneider@fhnw.ch

Pascal Moriggl
University of Applied Sciences Northwestern Switzerland, Switzerland
pascal.moriggl@fhnw.ch

Frank Grimberg
University of Applied Sciences Northwestern Switzerland, Switzerland
frank.grimberg@fhnw.ch

Abstract

Lego Serious Play (LSP) is a methodology that helps people brainstorm and discuss complex ideas through storytelling and metaphors. LSP has been successfully applied as a mechanism for creative learning and team building. In this paper, we discuss using LSP to teach core topics of Cyber Security and Resilience (CS&R) in higher education. Initial results suggest that LSP has a positive impact on student learning, while also improving student engagement both, within the course and in their business environment. While the use of LSP discussed here focuses on its implementation in CS&R courses, this highly transferable methodology can be applied across the spectrum of disciplines and for multiple purposes. In addition, it can also be used to facilitate cyber security awareness or risk assessment workshops in various environments.

Keywords: Cyber Security and Resilience, Cyber Security Awareness, Creativity, Gamification, Learning Experience, LEGO Serious Play, LEGO, Higher Education

INTRODUCTION

To realize the potential of the digital transformation, organizations need to develop strategies and processes to cope with digital privacy and security challenges. Businesses but also individuals are becoming ever more dependent on the so-called cyberspace - a place in which cyber-attacks are on the rise. This entails high risks, as criminals - the 'hackers' - could potentially take over medical equipment

or cars with automatic drive control, which in the end could even be life-threatening (Hernández-Ramos et al., 2013). The World Economic Forum (WEF) published a global risks perception survey in which 'data fraud and theft' was ranked as global risk number four, followed by 'cyber-attacks' (WEF, 2019). In this report, the WEF postulated that 'Cyber Risk Awareness' (CRA) is vital for businesses.

In 2017, this situation prompted us as a Higher Education Institution (HEI) to include a new course 'Cyber Security and Resilience' CS&R into our 'Business Information Systems' master program. In order to encourage either technically versed or more business-oriented students to deal with CS&R, we developed the curriculum in such a way that the students gain a basic understanding of CS&R with a strong focus on risk awareness. In order to motivate in particular our more business-oriented students for a topic which they considered difficult in advance because it seemed (too) technical, we decided, as is often the case in practice, to start the course with a risk awareness workshop using a creative and inspiring method. With such an initial setting, we aimed at engaging the students in the topic and its importance - both for private and professional application. We analyzed collaborative learning and student engagement techniques in HEIs (e.g., Barkley, Cross & Major, 2005; Barkley, 2009; Marshall, 2007; Frey, Ketteridge & Marshall, 2009, James & Nerantzi, 2019) and as a result identified LEGO Serious Play (LSP) as an adequate technique for both raising risk awareness in CS&R and enabling/enhancing communication within our workshop setting. For business students, courses in CS&R could serve as an integrative experience where international students apply their technical and management skills together. As a school of business, we take the view that studying on a master level must be more than just participating in an overview course flanked by practical examples. In the context of CS&R, many important principles and concepts are central to the practice of appropriate cyber protection, which usually are not covered in other courses forming the curriculum for the master program. The aim of this study is to refine LSP practices for use in CS&R courses in HEIs. The remainder of the paper outlines the research design and theoretical underpinnings of LSP. We describe the basic format of a series of LSP workshops in the learning field CS&R. Finally, we show a synopsis of the findings derived from the application of LSP that lead to reliable future options for research and action.

RESEARCH DESIGN

This study was conducted within a HEI, the University of Applied Science in Northwestern Switzerland (FHNW) as an 'insider research'. We used an interpretative qualitative research approach with participatory elements to explore the world from students'/participants' point of view by focusing on their lived learning experience. Denzin and Lincoln (2005, p. 641) described such an interpretive setting as a narrative which tells us how people make sense of their world. We focused on the learnings and team-building capabilities of the students, e.g., their social interactions and constructionism. The research objective was raising awareness about cyber risks. With this focus, we were able to discover and test LSP as a methodology that offers inspiring learning scenarios for CS&R courses. Our study was designed as a participative inquiry of our CS&R courses, in particular the introductory lecture, and the very last lecture. It was important to us from the beginning to replace exclusive roles of researchers/teachers and students with a co-operative relationship, so that all those involved worked together, as so-called 'co-researchers' and 'co-subjects' (Heron & Reason, 2001, pp. 179-80). During the lecture, we observed the students' activities and conducted small interviews on the side and after the lesson. We paid careful attention to ensure an effective rapport so that the respondents could to see the interviews as a collaborative activity, begin to trust the researchers/teachers and speak openly and

honestly. Such an open atmosphere is a requirement to effective interviewing (Mears 2017; Gray 2018). We relied on interviews as they are predestined to capture verbal and non-verbal data (Cohen et al., 2011). Moreover, the data can be used for qualitative and quantitative analysis (Feilzer 2010). Gray (2018, p. 434) also argues that interviews may be considered the best approach if the objective of a research is largely exploratory.

In the surveyed CS&R courses, the introductory lecture focused on the subject of CRA. The CRA discussion was organized in team-oriented workshops and characterized by various international students specific challenges, e.g., heterogeneous knowledge, learning culture and the getting to know one another and the formation of so-called 'awareness teams'. For such settings, we experimented with LSP assuming that it would help us by stimulating the students' creativity by modeling of artifacts and for team building (Rieber, Smith & Noah, 1998; Blair & Rillo, 2016).

THEORETICAL UNDERPINNINGS OF LSP

In 1958, the LEGO Company based in Denmark patented the brick design named LEGO. The name is an abbreviation of the two Danish words 'leg' and 'godt', meaning 'play well'. Today, LEGO is known for the bricks' clicking together feature with clutch power. In the mid of the 1990s, the LEGO group developed and used LSP internally for their strategy processes. Approximately ten years later they decided to introduce it to external partners in a special partnership model. In 2009, LSP became sort of 'open source' and has since been open to the public. Today, LSP is well established as a business technique and has been widely used in a number of contexts (e.g., Kristiansen & Rasmussen, 2014; Blair & Rillo, 2016; Rasmussen Consulting, 2019a). LSP is a highly participative facilitated methodology, the value of which has long been recognized (Rieber, Smith & Noah, 1998). It helps people brainstorm and capture visual metaphors through brick building and storytelling with the LEGO models. The two pioneers Kristiansen and Rasmussen (2014), defined LSP as a 'facilitated thinking, communication, and problem-solving technique for organizations, teams and individuals which draws on research from the field of business, organizational development, psychology, and learning'. The LEGO Group (2010), who had the original idea of using LEGO bricks outside the children's room, celebrates the use of LSP as a rejection of the idea that external 'experts' must be introduced to an organization to identify problems and to propose solutions. If LSP is used, it is assumed that the solutions are 'already in the room' and all participants are invited to 'think with their hands' to build, present, and share their understandings.

Values and Process

LSP essentially builds on three core values (Frick, Tardini, & Cantoni, 2013): (1) 'The answer is in the system', (2) 'Everyone has to express his/her reflections' and (3) 'There is no ONE right answer'. LSP can be seen as a process, which enables people to explore ideas by using LEGO bricks and other LSP material (Blair & Rillo, 2016). The facilitation of an LSP-based process is organized as a series of steps, where participants are asked a question, then build a LEGO model and subsequently tell a story by explaining their LEGO model and thereby they develop a shared understanding of a specific question/topic. The core process facilitated by a moderator can be divided into four essential steps: (1) 'The facilitator poses a question/challenge', (2) 'Participants build their answers using LEGO bricks', (3) 'Participants share their answers with other participants', and (4) 'Participants reflect on what they have seen and heard' (Frick, Tardini, & Cantoni, 2013). Many LSP practitioners refer to this process as a 'programming language' that can be used to solve a given problem (Kurkovsky, 2015). The different

LEGO models act often as a low threshold for discussions; participants open up and start brainstorming and discussing their ideas together, explore, and often find unexpected solutions/explanations to the presented question.

Theories of Learning

Within LSP, the 'play' is very important. The idea of 'play' is well explored in education and in the following, we will only outline the essential evolutionary steps that are needed to understand the benefits of LSP. We begin with Piaget (1936), a pioneering and enduring influencer in education research. He first introduced the theory of 'constructivism' in education, a learning situation when the learner's knowledge and meanings are 'constructed' through the interaction of their ideas and experiences. In a 1970 interview conducted he claimed: 'You cannot teach concepts verbally; you must use a method founded on activity.' Papert (1986) extended the idea of constructivism to 'constructionism' with the belief that people learn by creating and testing mental models of the world around them and claimed that learning can be more effective when learners are enabled to create physical models in the real world. In the following years, there was much research done on the positive influence of the motivational aspect of 'play' to motivate learners (e.g., Kirriemuir and McFarlane (2004); Buckley & Doyle, 2014; Hartmann & Gommer, 2019). In the recent literature, the term 'gamification' is used to circumscribe the application of game design elements to nongame scenarios. Deterding et al. (2011) described gamification as activities using elements of experiences only, as opposed to complete play experience (toys) or complete game experiences. Procopie et al. (2015) mentioned that besides having 'fun', games are highly engaging; they motivate and retain users/game participants within the environment. This effect is one of the reasons why gamification has become an emerging business practice, used in top companies such as Microsoft, Nike, Dell, Siemens, Deloitte etc. Thus it is not far fetched that Rasmussen (2019b) recently linked LSP to the techniques of 'Design Thinking', which heavily rely on making people move and use hands to prototype ideas into tangible objects, both – LSP and Design Thinking aim to motivate people to learn and keep the energy high.

Exemplary Applications

LEGO bricks are being successfully used in different contexts. A broad review of LSP applications within European business contexts was compiled by Frick, Tardini and Cantoni (2013). For HEIs offering lectures in business informatics or similar programs, numerous examples can be found for example in 'Creativity Promotion' for students in 'Management Information Systems' (Oberer, 2013), in 'Team Building' for students in 'Information Technology' (Scharlau, 2013). In addition, there are case studies and method descriptions available in 'Engineering' (Bulmer, 2011), 'Agile Software Methods' (Paasivaara, Heikkilä, Lassenius & Toivola, 2014), 'Software Engineering' (Kurkovsky, 2015) or even in 'Nanotechnology' with focus on multidisciplinary student teams (Jensen, Seager & Cook-Davis, 2018). It is worth mentioning that in 'Engineering' a specialized LEGO line has become popular – the 'LEGO Mindstorms', which allows combining bricks that are programmable with electric motors, sensors, and 'LEGO Technic' pieces (such as gears, axles, beams, and pneumatic parts) to build robots and other automated or interactive systems (LEGO Group, 2015). However, although the basis of LSP is supported by adequate learning theories and practices, it has yet seen little application in HEI contexts or more precisely in CS&R lectures.

APPLICATION IN CS&R

The main target of teaching CS&R in our master program is firstly to raise the students' awareness about the relevance of the topic in general and secondly show business-oriented risk scenarios and potential mitigating controls. Within an LSP-based workshop, CS&R students are encouraged to develop reasonable (future) scenarios in a short time (commonly three hours). With the belief that teaching CS&R and particularly raising risk awareness requires techniques that are innovative and entrepreneurial in nature, we identified LSP as a reasonable method and piloted it as a complementary instructional technique in our course in 2017. Based on the promising pilot results, we assumed that students could further benefit from the LSP experience and we used this form of 'thinking with the fingers' to treat various challenges in CS&R, including team building. Furthermore, we appreciated the leeway of mixing Design Thinking techniques with LSP (Panke & Harth, 2018; Rasmussen, 2019b). Therefore, our LSP pilot based on action research was extended to subsequent CS&R courses and risk awareness sessions in various contexts.

Guiding Principles

The LSP workshop was performed by adopting the basic values and the four-step process as described above in Section 3 (values and process); both are derived from Kristiansen and Rasmussen (2014) and Rasmussen Consulting (2019a). The workshop itself was guided by three simple rules: (1) 'The student/builder owns their model' and labels as well as photographs the finished model for documentation (and personal memory), (2) 'The metaphor of the model belongs to the student/builder', and (3) 'Every discussion concerns the model (not the student/builder)'. Moreover, we agreed upon three basic guidelines: (1) 'Trust your hands', (2) 'Trust the process' moderated by a facilitator', and (3) 'Everybody builds and takes part - no exceptions'. Each CS&R workshop was processed with the following four rules: (1) 'Facilitator proposes a CS&R-related challenge' (e.g., raising risk awareness or mitigating controls for risks), (2) 'Students build an artefact, a model with LEGO bricks', (3) 'Students share - all of them explain their modeled artifact', and (4) 'Students reflect and receive feedback regarding their modeled artifact'.

Process

The workshop followed the guiding principles and a specially developed facilitating script: First, students were introduced to the (1) objectives of the workshop (e.g., discussing potential cyber risks with peers and identifying sufficient mitigating controls), (2) a workshop overview with a detailed LSP workshop plan was provided, and as (3) we continued with an explanation of the LSP approach and underpinning learning theories. (4) Finally, before we started with practical tasks we explained the guidelines prepared on a flipchart. In subsequent workshops, we varied the degree of detail depending on the audience. We tried to keep the introduction sequence as short as possible in order to get into action as quickly as possible with a series of warm-up tasks designed to take students from building an object (e.g. a tower, a house or Monday morning tasks), through building representations, to building analogies and metaphors.

With the formalities complete, we started with distributing an LSP 'exploration kit' for each student (Note: These are very fundamental kits with 48 pieces at a cost of around 6$/package.). While the students were working with the LEGO pieces, we emphasized that 'play' is a relevant learning method, but that we were nonetheless pursuing very serious goals. After a few minutes, we explained the first

task, which was the construction of a freestanding tower within two minutes. A friendly competition started immediately with regard to the height of the tower, along with some commentary about the progress of students. We celebrated the tallest tower after two minutes. During this warm-up phase, the students built various models and shared the results with each other. After about 20 minutes, we initiated the second phase by introducing the process of building symbolic representations on cyber risks with LEGO. By this stage, students started at the latest to share and reflect their models with other group members. Here, we learned that it is essential for the commitment to the process that our students had enough time and space to engage. As shown in Picture 1, individual models can be combined to a shared model created by the students at the end of the workshop - the final CS&R landscape. The latter helped the students teams builda consensus constructed out of individual and sometimes different perspectives by merging their models into a new and larger whole and thus developing a common understanding which was aligned to the workshops objectives and content – to raise CRA.

Picture 1: CS&R landscape - Individual models combined into a shared model

Findings

The aim of using LSP was helping students to master CS&R major topics along with building teamwork experience and promoting creativity. We evaluated the results with qualitative methods (mainly interviews and analysis of written feedback) from two complementary perspectives - the first focus was on educational success, lessons learned in the context of learning theories and within a HEI whereas the second focused on students' learning experiences. In this depiction of findings, we focus on the second, the student's perspective (Note: the results of the first perspective will be published in a subsequent article (Part II: The Educational Experience). At the end of each LSP workshop and additionally at the end of the semester, students were asked to reflect whether the LSP-based workshops helped them to understand and learn the CS&R content (presence time and course material). Furthermore, students provided written feedback in the course evaluation questionnaire. Table 1 and Table 2 show a selection of responses gathered in the 2017 pilot course (Note: students' names are pseudonymized to protect their privacy). While reviewing the written comments it became clear that students generally agreed that their LSP experience did enhance the performance of their team in terms of team bonding, understanding each other, knowing experience in the CS&R field and encouraged an active participation in the lecture.

Table 1: Interviewee's open question responses (selection)

Statement	Source	Interviewee
'The three-dimensional building with Legos inspired me and I am now sure that I will meet the requirements of the course … I have already met peers and will work on the assignment with you'	Interview	Maria S.
'At first I thought it was childish, but now I have learned so much about cyber risks and how to deal with them ... I'm sure I can keep that for a long time'	Interview	Ritu M.
'I especially liked working in different teams, I met many of my student colleagues today ... and that at the beginning of the course, that will certainly help me during the course'	Interview	Luca H.
'I particularly liked the complete scenario at the end. I never thought that our small models could become such an interesting landscape with so many different ideas. I'm really glad I chose this course'	Interview	David F.
'I have never played with Legos. It was the first time in my life. I am really surprised that I had so much fun and that I was able to contribute to the team and our map'	Written feedback	Rahel J.
'I would have needed more time for my models, but basically there was a good insight into the topics that we will work on in this course'	Written feedback	Jelizaveta H.

Students were also asked for feedback regarding what they liked or disliked. The most frequent comment regarding what they liked focused on the interactive, creative, and relaxing environment that helped 'break the ice' allowing them to better communicate with and learn about their teammates. The most frequent comment regarding what they disliked was that they did not know how and whether the workshop would be relevant to the exam.

Table 2: Condensed benefits from facilitator/action research observations

Condensed benefits from facilitator/action research observations	Impact on
Setup of an unconventional and surprising starting point for all workshop participants; this helped keep students interested and motivated to participate.	Motivation
Setup of mixed teams thrown together repeatedly; this helped to awaken a creative mood and was identified as advantageous in our inhomogeneous student group with different cultural backgrounds.	Team Building
Working out of different experiences of the students, which leads to a high diversity of the CS&R-related influencing factors (e.g., identified risks and potential mitigating controls.	Desired Learning
Classification and categorization of the identified influencing factors; they could be experienced in three-dimensional models related to other risks.	Desired Learning
Every student was able to explain their own model (risk scenario), such from other students' models and the complete risk scenario landscape at the end; of course with different focal points, planks, and levels of detail, but understandable and comprehensible as a whole.	Desired Learning
The whole group accepted the results as reasonable and traceable (CS&R-related influencing factors, such as risks, mitigating controls, and relationships).	Desired Learning

In summary, the result of the student surveys was very positive with a few exceptions. In the following, we show some derived benefits of using LSP in the CS&R workshops condensed from student's feedbacks.

CONCLUSION

The LSP workshop design so far has proven to be successful. Even reserved students, who struggled initially to build representations of e.g. risks or mitigating controls, achieved a reasonable result and contributed to the CS&R landscape that represent a single narrative embedded in a group narrative. The 'reflect and sharing' practices in the workshops were very effective and were appreciated by the students. The focus on the models rather than individuals and the requirement for each person to share, created a level playing field. The analysis of the qualitative data collected from the students (table 1 & 2) showed clearly that LSP had a positive impact on our students' interest and learning in a CS&R course at master level. Compared to more traditional teaching methods, LSP-based activities resulted in students reaching high motivation, understanding of core elements, and in particular CRA. Collected data and the written and informal feedback from students suggest that LSP helped improve soft skills, such as team building or presentation capabilities. Students indicated that LSP increased their motivation, promoted creativity, and improved retention by actively engaging students into the coursework. Some students reported that having their photographed models in front of them made them feel more relaxed in the exam situation. Students extensively took pictures of their models and shared them e.g., on social media, which not only helped them extend their reflection of the models, but also indicated that they were proud of their work. Overall, using LSP in student courses is always fun and helps break up routines. Furthermore, LSP helps encourage a creative and imaginative classroom atmosphere.

In conclusion, the study presented here with focus on students' learning experience demonstrates that LSP can be effective in educational resp. academic (HEI) contexts. It is undisputed that the high cost of the LSP material is a big disadvantage so that it can only be used to a limited extent and that it quickly wears out and/or is decimated through use. In addition, it is relatively time-consuming for the professor/facilitator when compared to more traditional approaches such as discussions or a written report. Overall, in 2020 LSP has proven its validity across disciplines. However, in order to develop LSP as a common method within educational research (focused on HEI), more work, in particular with quantitative empirical results will need to be carried out to establish widespread acceptance.

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