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Design Thinking, Making and Serious Play: Similarities, Differences, and Workshop Concepts

Stefanie PANKE
University of North Carolina at Chapel Hill, USA
panke@email.unc.edu

Thilo HARTH
Fachhochschule Münster, Germany
thilo.harth@fh-muenster.de

This article explores educational media pedagogies that are predominantly non-digital, but nonetheless timely and influential. Design Thinking, Making, and Serious Play are three distinct yet interrelated approaches to problem-solving, resilience and innovation that have gained increased traction in education over the past decade. We explore the similarities and differences between these playful, experiential pedagogies and provide an overview of how these approaches can be integrated effectively into education settings. Finally, we provide transferable examples, including evaluation results, from a weeklong workshop series at Muenster University of Applied Sciences conducted in Spring 2022. The article serves as a theoretically informed practical guide for educators and practitioners seeking to select, implement and evaluate playful pedagogies. It contributes to the understanding of underlying principles, characteristics, potential impact and limitations.

Keywords: Design Thinking, Making, Serious Play, Playful Pedagogies

Introduction

Learning can be playful, wonderful, a way of understanding and making sense of the world" (Ferguson et al. 2019, p. 9): The 2019 edition of the Innovating Pedagogy report highlighted the role of play in k12 environments, at universities and in continuing education. Play should remain a central component of teaching and learning throughout life. "*Students at play can learn better, form stronger social bonds, and make more imaginative leaps*" (Jensen et al., 2018, p. 266). Play and creativity resonate with the mission of universities: "*Institutions of higher education are concerned with developing the next generation of critical thinkers that can work creatively across disciplines to solve the world's grand challenges*" (Hynes & Hynes, 2018, p. 869). At the same time, these concepts are versatile across subject areas: "*The design of creative products to show understanding or communicate ideas can be incorporated into any topic or subject"* (Trust et al., 2018, p. 26).

The article describes selected workshop activities that the authors facilitated at Muenster University of Applied Sciences (Germany) in April 2022. The workshops engaged participants in LEGO serious play, design thinking and maker activities to orchestrate pedagogical planning both in vocational schools and for vocational teacher education courses. All workshops took place in a newly designed room with flexible furniture. The authors evaluated workshop outcomes by observing, documenting results, conducting a post-workshop online survey and three follow-up expert interviews with participants. For each workshop activity, we offer a description and critical analysis of facilitation technique and choices, documenting our observations of major productive outcomes, as well as barriers and limitations.

The structure of the article is as follows: The theoretical overview provides clarification of the terms design thinking, making and serious play. It then summarizes previous case studies and literature reviews on their respective application in education. The Case Study section discusses workshop activities and evaluation results. The Discussion highlights critical lessons learned, summarizing impact and limitations. The Outlook points to current pedagogical endeavors and future research.

Theoretical Overview

Making, LEGO serious play (LSP) and design thinking are distinct, yet connected creative approaches that center the virtue of tinkering, failing, iterating and developing new skills by venturing into unfamiliar terrain. There are many connections between serious play, making, and design thinking. For example, in many cases design thinking activities involve the use of LEGO bricks, and makerspaces oftentimes incorporate design thinking techniques to create low-fidelity prototypes. The shared potential for higher education is reframing campus as a space for students to be understood and grow intellectually instead of being perceived as '*a factory of grades to give legitimacy for*

governments funding' (Alayan, 2020). Table 1 summarizes the three concepts, providing an overview of similarities and differences.

Table 1
Comparative Overview of Making, Design Thinking, and LEGO Serious Play in Educational Contexts.

Concept	Definition	Origin	Uptake in Education	Characteristics
Making	The act of creating, building, or tinkering with confidence.	DIY movement and Maker Faire phenomenon.	Adopted in schools, libraries, universities and community centers to promote hands-on, creative learning and metacognition (grit, persistence)	Inclusivity, creativity, hands-on learning, rapid prototyping, iteration.
Design Thinking	A problem-solving approach involving empathy, creativity and rapid prototyping.	1960s in design and engineering fields.	Integrated into curriculum and extracurricular activities to foster problem-solving and innovation.	Empathy, collaboration, creativity, problem-solving, iteration, human-centered approach.
LEGO Serious Play	A facilitation methodology using LEGO bricks for problem-solving.	Developed by LEGO in the 1990s.	Used as a tool to enhance creative thinking, problem-solving, well-being and teamwork among students.	Creativity, collaboration, engagement, hands-on learning, play for learning and innovation.

Maker Culture, Makerspaces and Maker Pedagogy

Makerspaces are collective places that facilitate design and prototyping for individuals and groups by offering access to technical equipment and material together with expertise, guidance and training. The shared workspace allows engineers, designers, scientists, students, and hobbyists to create, fabricate, tinker, and bring their ideas to life. Making encompasses traditional skills like crafting and knitting as well as modern skills like coding, programming, and robotics. Alongside the rise in popular interest of the maker movement, makerspaces are visibly on the rise in schools and universities, and are now a commonly found part of campus infrastructure. In 2013, the Innovating Pedagogy report described maker culture as Maker culture as characterized by playful learning, encouraging both the acceptance of risk taking and rapid iterative development (Sharples at al., 2013). In a makerspace, learners get feedback through immediate testing, personal reflection, and peer validation. Learning is supported via informal mentoring in a community of practice. The 2016 Horizon Report identified makerspaces as one of the key technological developments that will shape the future of higher education. The educational sector has acknowledged the capacity of Makerspaces to encourage cross-disciplinary cooperation and autonomous learning. Meyer (2019) argues that makerspaces in higher education facilitate active, student-led inquiry through a room structured for experimentation, providing multi-sensory engagement for students that anticipates and accommodates their needs. Hynes & Hynes (2018) caution that unlike the structured design procedure typically employed for constructing educational infrastructures, thriving grassroots Makerspaces are predominantly formed when individuals with shared interests collaborate and modify the surrounding environment to suit their requirements. The provision of the infrastructure does not automatically imply the adherence to making principles and maker pedagogy.

Maker pedagogy draws from core tenants in the maker movement, and is characterized by student agency, hands-on learning, a focus on practical application and personal meaning. Bullock (2015) suggests that maker pedagogy offers an approach to engaging teacher candidates in thinking about curriculum choices and working with students. Maker pedagogy has been described by initiators of makerspaces as '*a cure for maladaptive perfectionism*' by providing '*exposure therapy for failure'* (Vaughn, 2022).

LEGO Serious Play (LSP)

Lego Serious Play (LSP) is an open source moderation method that uses Lego bricks to facilitate strategic planning, team building, problem solving, and creative expression. Participants work both as individuals and as a group to build simple models representing various concepts in response to a question posed by the facilitator. Robert Rasmussen describes serious play as 'an *intentional gathering of participants who want to use their imagination, agree that they are not directly producing a product or service, and agree to follow a special set of rules'* (Rasmussen Consulting, 2012). While LSP is less prevalent than design thinking or making, there are several documented case studies in educational settings: López-Fernández (2021) presented an original LSP activity to teach software engineering concepts in a playful and active way, which was validated through a case study involving computer

science students. Kurkovsky (2015) found that LSP can be used to teach software engineering by having students build models representing various concepts in response to a question posed by the facilitator. McCusker (2014) discussed the use of LSP in educational contexts, including getting at participants' understanding of their own professional identities. Hayes (2016) suggests that LSP could be integrated into the education and training of healthcare assistants to facilitate their affective learning around care and compassion. Jensen et al. (2018) reported on a series of undergraduate workshops on nanotechnology that tested the LSP method for facilitating deliberation in multidisciplinary teams of students. Jensen et al. (2018) stated that the scaffolded communication with LEGO models as metaphors helped to '*bridge gaps in knowledge, epistemology, and vocabulary'*. McCusker (2018) reported results related to equality and inclusion, overcoming 'some of the hierarchies and hegemonies' in diverse groups. Shipway and Henderson (2023) reported on the use of LSP to support the mental health and wellbeing of children and young people during educational transition periods. They see three potential outcomes (1) build resilience; (2) foster and support mindfulness; (3) enhance mental health. Dann (2018) outlines principles of the LSP process and how it can be adapted for classroom use in a 90-minute session, as described in table 4.

Table 2
Sample LSP Process Adapted for Education Settings (cf. Dann, 2018)

Phase	Activity	Purpose	Description	Role of Participants
Permission to Play	Tower Building	To familiarize participants with the LEGO set and the process of model creation.	Participants are asked to construct a tower that is "as elegant, as stable, and as tall as they feel comfortable building".	To build the tower, share the story of their tower, and listen to others' stories.
Permission to Own	From Metaphor A to Metaphor B (2 subsequent builds)	To encourage participants to associate a model with personal thoughts or goals and ask questions of the model in a manner that does not place meaning onto the other person's build.	Participants build a model following a pre-set sequence of bricks and then modify it to answer a specific question.	To construct and modify the model, answer the question using their model, and share their story.
Permission to Use	Call and Response (2 subsequent builds)	To stimulate creativity through scarcity and force participants to make decisions under uncertainty.	Participants select 15 LEGO pieces before knowing the purpose of the build, then construct a 'Call' model, engage in a discussion or reflective task, and then construct a 'Response' model with their remaining pieces.	To select pieces, construct the 'Call' and 'Response' models, engage in the discussion or reflective task, and share the story of both models.
Open-Ended Task	Facilitator-Designed Activity	To utilize the learned methods and techniques in an open-ended task designed by the facilitator.	The fourth phase build is left as an open-ended task for the facilitator to design a purpose and role for the question to be asked, and the process of discovery to be undertaken.	To participate in the facilitator-designed activity, which may involve creating models to outline desired roles within a team, or using the LSP process for goal setting, task orientation, and goal alignment.
Debrief	Discussion	To explain the process of Serious Play, constructionism, and the differences between the workshop and industry experiences.	A standard debrief script talks through the process of Serious Play, how constructionism uses different ways of thinking, and that it may be a new experience with surfaced thoughts or a slight case of brain itching post-session.	To listen, ask questions, and reflect on the experience.

Design Thinking

Design thinking is a practice and mindset that can be helpful to educators when addressing wicked problems. The term wicked problems was coined in the 1970s by planners who realized that the problems they were addressing were beyond complex: They combined a high level of uncertainty and risk with intense disagreement

and conflicting objectives among stakeholders and, as a result, had no ideal intervention that would address the issue (Rittel & Webber, 1973).. Design thinking offers an approach to these problems that integrates information across systems and across perspectives. While the concept of design thinking within the academic dialogue of design has been under discussion for more than 30 years, its recent adoption as an innovation method has lead to its popularity in various disciplines (Wigley and Straker, 2017).

The essence of design thinking in education is to put learners into contexts that make them think and work like an expert designer, and thereby foster civic literacy, empathy, cultural awareness and risk taking (Sharples et al., 2016). According to Skaggs (2018) the tools observation, experience and inquiry allow designers to understand human needs and shape information to drive the creation of products and experiences that make human connections through aesthetics, need-finding, or making meaning. Elsbach and Stigliani (2018) describe design thinking as an approach to problem solving that uses tools traditionally utilized by designers of commercial products, processes, and environments. According to Cochrane & Munn (2016) the three main elements of design thinking are observational research, visual sense making, and rapid prototyping.

Panke (2019) conducted a systematic literature review of design thinking in education that included 167 articles. Her analysis stated the following benefits found in different case studies: Tacit experiences, increased empathy, reduced cognitive bias, playful learning, flow, collaboration, productive failure, surprising solutions and creative confidence. In summary, Panke (2019) described design thinking as a versatile approach for orchestrating conflicting ideas, identifying singular needs and common goals, making productive use of diverse backgrounds, enhancing empathy, and developing a shared vision. However, the author also cautioned that unintended outcomes can entail creative over-confidence, misalignment with course objectives, teamwork conflicts, anxiety and frustration, shallow ideas, idea creation over evaluation and lack of long-term impact.

Case Study: Playful Pedagogy Workshop Series

Four days, 22 hours, three formats, 30 participants, 1000 LEGO bricks: In April 2022, students, faculty, vocational education experts, and teaching methodology specialists engaged in a series of workshops that tapped into maker mindset, design thinking, and serious play. Participants developed pedagogical ideas for using a new teaching space with flexible furniture at Münster University of Applied Science as well as innovative pedagogies for VET in different subject areas. The workshops took place in a newly designed room with flexible furniture that was intended to serve as 'a teacher education makerspace'. An implicit goal of the workshops was to generate pedagogical ideas for making effective use of the new learning space. Explicit curricular goals were (1) to gain an understanding of maker pedagogy (2) to explore LEGO Serious Play (3) to experience design thinking, (4) to integrate these approaches into the subject-specific, pedagogical repertoire, supporting teacher thinking. The three workshop formats differed in length (2.5 hours, 3.5 hours, 2 days) and audiences (faculty, staff, students).

Our qualitative exploratory case study analysis comprises of evaluation results (online survey), observations by the facilitators, and post-workshop discussions with participants and observers. Single case studies are particularly useful for exploring and documenting innovative teaching practices, offering detailed insights into their implementation, challenges, and successes. By systematically documenting and disseminating our workshop concepts, we want to encourage faculty colleagues to either integrate the creative pedagogies we describe into their own courses or enhance the original concept with modifications.

Love Letter – Break-up Letter (Design Thinking)

Empathy and divergent thinking are crucial in the initial phase of the design process to encourage heterodox perspectives. The love/breakup letter task allows participants to balance different perspectives in a personal way (Molinari & Gasparini, 2019). They reflect on both the strength and weaknesses of their organization in a low-risk, role-play format. The facilitator used this exercise in both faculty and student workshop settings. Participants were randomly assigned in two groups and asked to write a love letter or a break-up note to their degree program in vocational education and training (VET). We observed that faculty tended to switch groups based on preference, whereas students stayed with their random assignment. The student group created the most memorable output in the break-up letter: *'Three years at the university, One and a half years as teacher residents, and I still have no clue how real teaching works'.*

Figure 1
Love-Letter – Break-up Letter Exercise, groups with portable whiteboards

Rapid Prototyping (Design Thinking)

Both faculty and students engaged in a rapid prototyping cycle that is a typical component of design thinking workshop. In both groups, participants formed dyadic design teams. One partner shared a learning problem or teaching challenge, the other designed a solution. During the exercise participants cycled rapidly through a series of tasks geared to observe, brainstorm, synthesize, prototype and discuss. Each team went through four design sheets with structured prompts (cf. Table 3). This was particularly rewarding with the faculty participants, because many walked away with concrete ideas for changing classroom practices. For the student group the main benefit was that the design partners were able to practice teacher thinking.

Table 3
Stages and Timelines for Collaborative Design Thinking Process

Phase	Prompt	Duration
DEFINE & FOCUS:	Carefully listen to your design partner to understand the teaching / learning challenge you want to solve for this person. Remember: How you describe the problem affects the solution. Take notes and pay attention to precise, concise and action-oriented language. Present your problem description to your partner to check for correctness and completeness.	14 minutes 7 minutes per person to interview the design partner
GENERATE & DEBATE	Generate 3-5 ideas to address the problem with novel solutions or disruptive technologies. Aim for a large effect, broad reach and replicable results. Present to your partner.	20 minutes 10 minutes for individual ideating 5 minutes per person to get feedback from the design partner
SELECT & SKETCH	Choose one of your ideas and sketch it out in more detail (literally). Select the best-received, the most interesting to you, the most likely to be implemented, the most unusual or the solution with the most options for collaborating with others. Present to your partner.	2 minutes individual
BUILD & PRESENT:	Design a prototype or three-dimensional representation of your solution with the materials in the room (card board, paper, tape, clay). Let your partner / the group react to the prototype. Both express and receive positive and negative feedback, ideas for improvement or extension, and open questions.	18 minutes 10 minutes for individual building 5 minutes per person to get feedback from the design partner

Figure 2
Rapid Prototyping Cycle

LEGO models (Serious Play)

Both students and faculty played through the four steps of the LSP process (challenge, build, share, reflect) in a short and simple pair-share exercise that deployed an adapted version of Dann (2018) 'Permission to Play'. The prompt was structured into (1) building a tower, (2) placing yourself on that tower, and (3) describing the view from the tower with the goal of depicting a good thing the builders can see in their past, future or present (cf. Anat Shabi, 2022). They then moved to open-ended tasks of building a model of a teaching challenge. The most striking observation during the use of LEGO models was that participants were immediately engaged and that they interacted quite literally at eye level. Everyone was sitting on the floor, scouring for bricks, and curious to see the work of others.

Figure 3
LEGO model building, different groups

Micro-Bots (Maker Activities)

While faculty and staff received a lecture introduction to makerspaces and maker pedagogy, the two-day student workshop included short-term making projects of approximately 30 minutes build time. Participants formed three groups and created different microbots (doodle-bot, brush bot, tooth brush bot). Microbots are simple robotic devices that use vibration from a small motor to move, often created from everyday materials and used for

educational purposes to teach basic principles of physics and engineering. The facilitator also provided a Makey Makey set with a more open-ended task ('create anything'). Makey Makey is an invention kit that allows users to turn everyday objects into touchpads.

Presented with these choices, students gravitated towards the more concrete projects with instructions.

Figure 4
Maker activities, teacher candidates

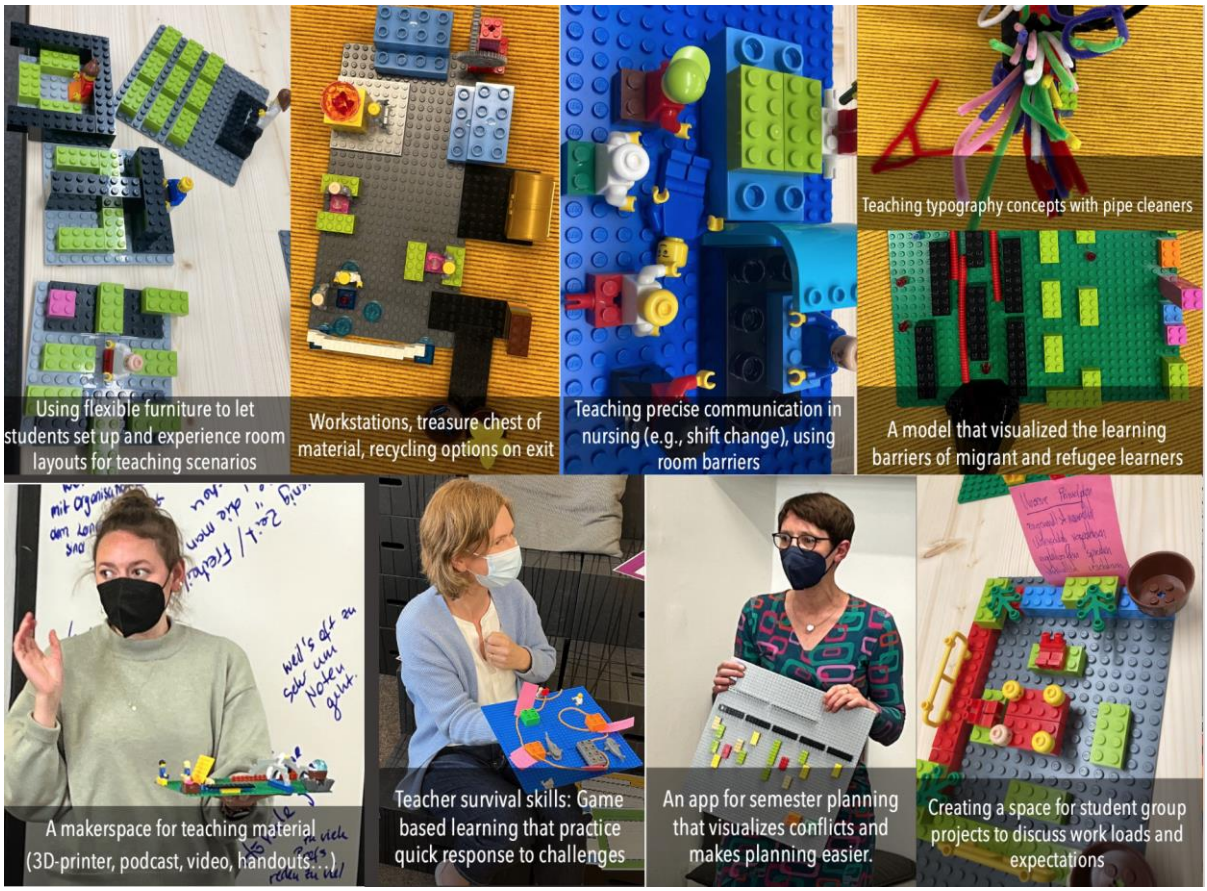
These short projects effectively illustrated the core principles of maker spaces. All groups initially failed in their design, and, after testing, had to hypothesize potential solutions, and iterate to succeed. All of them had to substitute materials and deviate from the instructions. Whereas some participants felt overly challenged, others felt that instructions were too detailed, and didn't leave enough room for their own ideas.

Sample Results

The workshops produced many creative ideas for making the most of the flexible furniture setting, addressing teaching and learning challenges for students, and for student-centered learning in VET classrooms, for example:

- Training precise communication in nursing during shift changes by using a room barrier to give instructions without visual clues. Flexible furniture can create visual barriers that allow teachers to focus on critical concepts for communication and documentation in healthcare. This idea was later picked up by a faculty and adapted for their subject area: "*Resolving different skill levels in a class by learning through teaching with a visual barrier between groups. Someone who is already familiar with a circuit diagram or a component, for example, explains to someone else how to proceed when wiring, building, or repairing.*"
- Teaching typography with pipe cleaners: One faculty member stated: 'You can take everything else out of this room, all I care about are these [pipe cleaners]'. She talked about how to use this to work through typographic characteristics in a haptic form so that students can more easily grasp basic concepts of typography.
- Student team work: Students often struggle with team members not contributing during project work. An introductory meeting that discusses individual workloads and goals can lead to a more realistic assignment of task within student teams.
- Makerspace for teaching materials: Turn the room into a makerspace for teaching materials where students can produce podcasts, handouts, infographics, exercises, quizzes and other learning materials in a self-directed, self-organized, fab-lab type environment.

Figure 5
Selected models and ideas



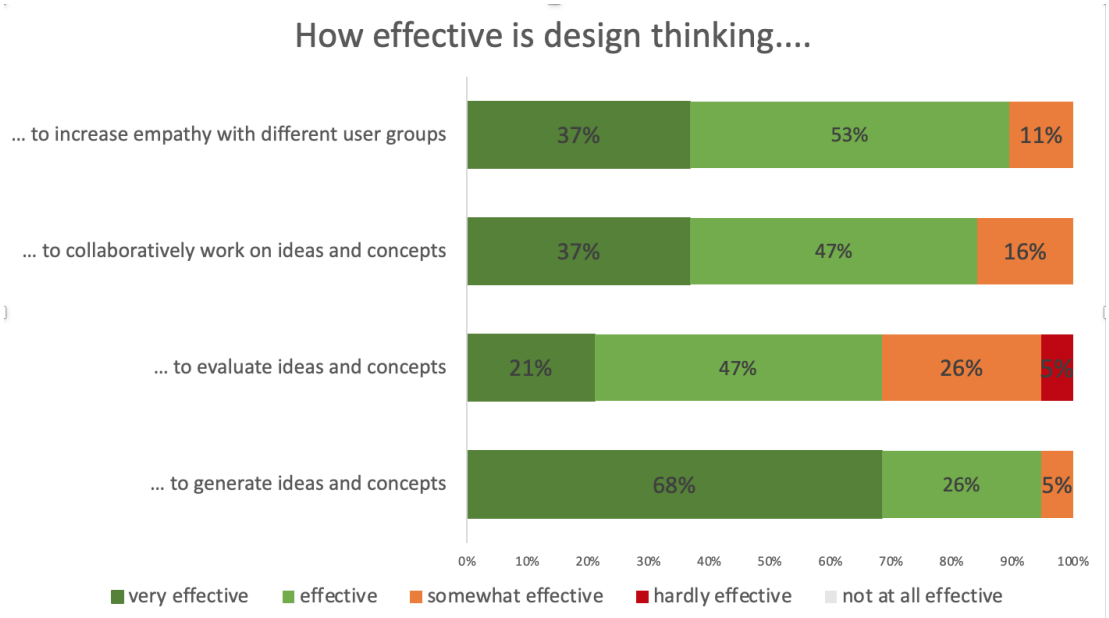
Evaluation

In the week following the workshop series, the authors distributed an online survey with the questionnaire tool Qualtrics that comprised of mostly open-ended questions. A total of 20 of the 30 participants answered the survey. The respondents were distributed as follows: 40% faculty, 25% staff, 35% students (n=20, answer to the question prompt 'What best describes your role?').

The authors were particularly interested in transfer from workshop to teaching practice and teacher thinking. Hence, the respondents were prompted to name techniques or results they found particularly interesting and considered using themselves as well as results that they remembered particularly well after the workshop. Making deliberate use of flexible furniture, ideas for leveraging LEGO blocks to create effective metaphors, specific design thinking techniques and, for faculty, an integration into their existing teaching repertoire emerged as themes. In the oral exams that were conducted with student in the week following the workshop, it became clear that the overarching perspective for this audience was gaining confidence in thinking and acting like a teacher, induced by the playful and varied workshop methods.

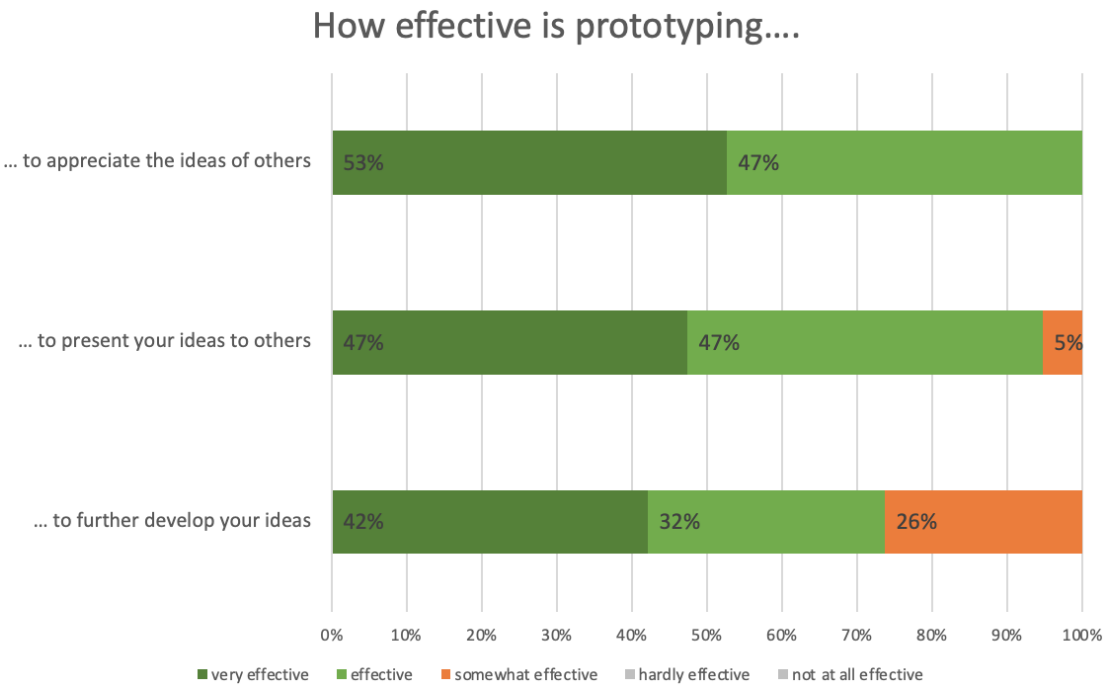
We included two Likert-scale questions that have been asked across all our design thinking workshops, pertaining to the effectiveness of design thinking in general and prototyping in particular. Responses document an overall positive experience with design thinking, in particular as a generative technique, as a format that increases empathy and encourages collaboration. The lowest score was given for the capacity to evaluate ideas and concepts, with 31% of responses indicating the workshop format as somewhat or hardly effective in this regard.

Figure 6
Effectiveness of design thinking (Please rate the effectiveness of design thinking based on your workshop experience. n=20)



Similarly, the aspect of prototyping that is a central component of design thinking was mostly seen as effective to appreciate the ideas of others and as a presentation aid. 26% of responses indicated prototyping as somewhat effective to further develop their ideas.

Figure 7
As how helpful did you perceive the prototyping? Please rate the effectiveness. (n=20)



Positive outcomes mentioned by students and faculty were (1) perceiving oneself as a teaching professional, (2) extending the instructional repertoire, (3) recognizing the importance of learning environment factors such as flexible furniture, (4) recovering agency and (5) experiencing joy and flow building models and prototypes. The major negative components were too much structure, and not enough critical thinking and discussion.

These problems were mirrored in our post-facilitation debrief discussions. Observers of the student workshop specifically criticized the tendency of teacher candidates to tackle comparatively easy challenges and drift to superficial exploration of subject matter concepts. Instead of addressing topics that are both hard to explain and difficult to understand, the students presented models of fairly basic, introductory level concepts that did not require a high level of subject matter expertise. We observed that the progression from building LEGO models to a design thinking rapid prototyping process was less productive than expected. Noticeably, instead of producing multiple solutions, selecting, critiquing and improving ideas, many participants went back to their early LEGO models. This observation may well be an artifact of our facilitation or of participant preferences, but it points to additional technical skills and effort for the productive combination of Lego Serious Play and Design Thinking. Ideally, the LEGO build challenges should create a safe space for exploration, so that the design thinking process yields risk-affine prototypes that address complex instructional challenges.

Discussion

Based on our review of the literature and from our own workshop experiences, Design Thinking, Making and Serious Play have significant conceptual overlap, yet distinct characteristics and facilitation techniques. For the purpose of our extending pedagogical repertoire and agency, it makes sense to explore these approaches in conjunction. However, facilitators need to recognize that all three approached are 'time-expensive'. Our lessons learned can be summarized as follows:

- **Progression towards Openness**: Easy-to build Making-Kits with building instructions provide a solid introduction to maker-principles. However, progression to openness is key. Maker activities should increase complexity and openness by using an introductory project, followed by a free design, thus moving from replication to innovation (cf. Holm, 2015).
- **Balance of Constraints and Abundance:** In our workshops, LEGO building activities struggled with effective time management. While it was extremely engaging for participants to build from a large collection of bricks, smaller, more selective and purposefully curated sets are superior for fast-paced, introductory activities, whereas collective models can profit from a large, shared stock of bricks.
- **Turning Ideas into Objects:** Wengel et al. (2021) explored LSP in tourism studies and found that it allowed participants to communicate potentially sensitive issues such as interpersonal and intercultural conflict more neutrally. We saw this advantage across all playful techniques we explored in the workshop series, most pronounced in the 'Love-Letter, Breakup-Letter' activity.
- **All Design is Redesign**. Several participants pointed out in the evaluation that the new techniques they encountered were already somewhat familiar ("*making and design thinking are hidden in many existing teaching methods*", *"creative micro-methods that have been used in teaching for a long time").* The statement "All design is redesign" is often attributed to the UI/UX specialist Jared Spool. The sentiment behind the phrase suggests that every new design borrows or builds upon previous designs, concepts, or ideas, as a reinterpretation of what has come before. We plan to integrate this motto into the debrief phase to offer a bridge between established pedagogical practices and innovation by looking for the familiar roots of new ideas.
- **Speeding Up, Slowing Down, Confronting 'Real Teaching':** While the fast-paced, gamified process of design thinking and serious play creates flow and engagement, this can be fruitfully combined with a more long-term process of making, that is, creating artifacts that are deeply meaningful and of personal value to the learner. To achieve this goals, the short-term workshop would need to be combined with longer-term projects. This is specifically important for pre-service teachers who can use a 'teacher makerspace' for designing lesson material that they intend to use in classrooms.

Outlook

The purpose of this case study was both exploratory and intrinsic following the typology described by Baxter and Jack (2008). An intrinsic case study is conducted with the aim of gaining a deep understanding of a specific, interesting case in its own right, rather than to generalize findings to other cases. Exploratory case studies are typically preliminary, aimed towards a new area where there is little existing knowledge, and conducted with the purpose of identifying questions for further study and investigation.

The authors provided a theoretical exploration of design thinking, serious play and making alongside practical examples that facilitators can re-use, repurpose and adapt. To make further use of the makerspace for teacher education, the author team is planning a follow-up course that is centered around the production of learning material for pre-service vocational teachers. Aligning design thinking and making, the new workshop format is intended to expose students to an agile mindset that will help with bridging the transfer gap of pedagogical theory and classroom realities.

References

Alayan, A. (2020). When Students Design University: An Interview with Alessandra Molinari & Andrea Alessandro Gasparini. AACE Review. https://www.aace.org/review/when-students-design-university-an-interview-with-alessandra-molinari-andrea-alessandro-gasparini/

Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. The qualitative report, 13(4), 544-559.

Bross, J., Acar, A. E., Schilf, P., & Meinel, C. (2009, August). Spurring Design Thinking through educational weblogging. In Computational Science and Engineering, 2009. CSE'09. International Conference on (Vol. 4, pp. 903- 908). IEEE.

Brown, A. (2017). Exploring Faces and Places of Makerspaces. AACE Review. https://www.aace.org/review/exploring-faces-places-makerspaces/

Brown, T. (2009). Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation. New York: HarperCollins Publishers.

Brown, T., & Wyatt, J. (2010). Design thinking for social innovation. Development Outreach, 12(1), 29-43.

Buchanan, R. (1992). Wicked problems in design thinking. Design issues, 8(2), 5-21.

Budd, A., Dinkel, H., Corpas, M., Fuller, J. C., Rubinat, L., Devos, D. P., … Wood, N. T. (2015). Ten Simple Rules for Organizing an Unconference. PLOS Computational Biology, 11(1), e1003905. https://doi.org/10.1371/journal.pcbi.1003905

Cantoni, L., Marchiori, E., Faré, M., Botturi, L., & Bolchini, D. (2009, October). A systematic methodology to use lego bricks in web communication design. In Proceedings of the 27th ACM international conference on Design of communication (pp. 187-192). ACM.

Cassim, F. (2013). Hands on, hearts on, minds on: design thinking within an education context. International Journal of Art & Design Education, 32(2), 190-202.

Cochrane, T. & Munn, J. (2016). EDR and Design Thinking: Enabling Creative Pedagogies. In Proceedings of EdMedia 2016--World Conference on Educational Media and Technology (pp. 315-324). Vancouver, BC, Canada: Association for the Advancement of Computing in Education (AACE). Retrieved April 3, 2018 from https://www.learntechlib.org/p/172969/.

Cooper, A. (1999). The inmates are running the asylum:[Why high-tech products drive us crazy and how to restore the sanity]. Indianapolis: Sams.

Deissinger, T., & Hellwig, S. (2005). Apprenticeships in Germany: modernising the dual system. Education+ Training, 47(4/5), 312-324.

Deissinger, Thomas. "The German dual system-a model for Europe?." Education+ Training 39, no. 8 (1997): 297-302.

Dohmen, D. (2018). Prognose der Schüler*innenzahl und des Lehrkräftebedarfs an berufsbildenden Schulen bis 2030. FiBS Forschungsinstitut für Bildungs- und Sozialökonomie, GEW. https://www.gew.de/fileadmin/media/publikationen/hv/Berufliche_Bildung/20180309_Bedarfanalyse-Schueler_innenzahl_web.pdf

Elsbach, K. D., & Stigliani, I. (2018). Design Thinking and Organizational Culture: A Review and Framework for Future Research. Journal of Management, 0149206317744252.

Ferguson, R., Barzilai, S., Ben-Zvi, D., Chinn, C.A., Herodotou, C., Hod, Y., Kali, Y., Kukulska-Hulme, A., Kupermintz, H., McAndrew, P., Rienties, B., Sagy, O., Scanlon, E., Sharples, M., Weller, M., & Whitelock, D. (2017). Innovating Pedagogy 2017: Open University Innovation Report 6. Milton Keynes: The Open University, UK. Retrieved April 3, 2018 from https://iet.open.ac.uk/file/innovating-pedagogy-2017.pdf

Frick, E., Tardini, S., & Cantoni, L. (2014). Lego Serious Play applications to enhance creativity in participatory design. Creativity in business. research papers on knowledge, innovation and enterprise, 2, 200-210.

Goldschmidt, G. (2017). Design Thinking: A Method or a Gateway into Design Cognition?. She Ji: The Journal of Design, Economics, and Innovation, 3(2), 107-112.

Heikkinen, S., & Nemilentsev, M. (2014). Lego Serious Play as an innovative method of learning. Innovative Teaching and Learning Methods in Multicultural Environments. Mikkeli: Mikkeli University of Applied Sciences, 18-26.

Hodgkinson, G. (2013). Teaching Design Thinking. In J. Herrington, A. Couros & V. Irvine (Eds.), Proceedings of EdMedia 2013--World Conference on Educational Media and Technology (pp. 1520-1524). Victoria, Canada: Association for the Advancement of Computing in Education (AACE).

Holm, E. J. V. (2015). Makerspaces and Contributions to Entrepreneurship. Procedia - Social and Behavioral Sciences, 195, 24–31.

Hunt, V., Prince S., Dixon-Fyle, D. & Yee, L. (2018). Delivering Through Diversity. McKinsey & Company Report. Retrieved April 3, 2018 from https://www.efm-berlinale.de/media/pdf_word/efm/68_efm/microsites/horizon/diversity-report.pdf

Hynes, M. M., & Hynes, W. J. (2018). If you build it, will they come? Student preferences for Makerspace environments in higher education. International Journal of Technology and Design Education, 28(3), 867–883.

Jensen, C. N., Seager, T. P., & Cook-Davis, A. (2018). LEGO® SERIOUS PLAY® In Multidisciplinary Student Teams. International Journal of Management and Applied Research, 5(4), 264–280.

Kansanen, P. (2009). Subject-matter didactics as a central knowledge base for teachers, or should it be called pedagogical content knowledge? Pedagogy, Culture & Society, 17(1), 29–39.

Lehr D. (2011). Belastung und Beanspruchung im Lehrerberuf: Gesundheitliche Situation und Evidenz für Risikofaktoren. In: Terhart E, Bennewitz H & Rothland M. (Hrsg): Handbuch der Forschung zum Lehrerberuf. Münster: Waxmann, 757–773.

Li, J., & Pilz, M. (2021). International transfer of vocational education and training: a literature review. Journal of Vocational Education & Training, 1-34.

Liedtka, J. (2015). Perspective: Linking design thinking with innovation outcomes through cognitive bias reduction. Journal of Product Innovation Management, 32(6), 925-938.

Lindberg, T., Meinel, C., & Wagner, R. (2011). Design thinking: A fruitful concept for it (IT?) development?. In Design Thinking (pp. 3-18). Springer Berlin Heidelberg.

Matthews, J. H., & Wrigley, C. (2017). Design and design thinking in business and management higher education. Journal of Learning Design, 10(1), 41-54.

McCusker, S. (2014). Lego®, Serious Play TM: Thinking About Teaching and Learning. International journal of knowledge, innovation and entrepreneurship, 2(1), 27-37.

Melles, G., Howard, Z., & Thompson-Whiteside, S. (2012). Teaching design thinking: Expanding horizons in design education. Procedia-Social and Behavioral Sciences, 31, 162-166.

Mersand, S. (2021). The State of Makerspace Research: a Review of the Literature. TechTrends 65, 174–186.

Meyer, J., & Land, R. (2003). Threshold concepts and troublesome knowledge: Linkages to ways of thinking and practising within the disciplines (pp. 412-424). Edinburgh: University of Edinburgh.

Meyer, J. H., & Land, R. (2005). Threshold concepts and troublesome knowledge (2): Epistemological considerations and a conceptual framework for teaching and learning. Higher education, 49(3), 373-388.

Molinari, A., & Gasparini, A. A. (2019). When students design university: a case study of creative interdisciplinarity between design thinking and humanities. Open Education Studies, 1(1), 24-52.

Oygür, I. (2018). The machineries of user knowledge production. Design Studies, 54, 23-49

Özer, M. (2020). Vocational education and training as "A friend in need" during coronavirus pandemic in Turkey. Bartın University Journal of Faculty of Education, 9(2), 1-7.

Panke, S., Gaiser, B., & Werner, B. (2007). Evaluation as Impetus for Innovations in E-learning—Applying personas to the design of community functions. MERLOT Journal of Online Learning and Teaching, 3(2), 179-190.

Panke, S. & Harth, T. (2018). Design Thinking for Inclusive Community Design: (How) Does it Work?. In T. Bastiaens, J. Van Braak, M. Brown, … O. Zawacki-Richter (Eds.), Proceedings of EdMedia: World Conference on Educational Media and Technology (pp. 284-296). Amsterdam, Netherlands: Association for the Advancement of Computing in Education (AACE).

Panke, S. (2019). Design thinking in education: Perspectives, opportunities and challenges. Open Education Studies, 1(1), 281-306.

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. Policy sciences, 4(2), 155-169.

Sanders, E. B. N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. Co-design, 4(1), 5-18.

Scheer, A., Noweski, C., & Meinel, C. (2012). Transforming constructivist learning into action: Design thinking in education. Design and Technology Education: An International Journal, 17(3).

Sharples, M., McAndrew, P., Weller, M., Ferguson, R., FitzGerald, E., Hirst, T., & Whitelock, D. et al. (2014). Innovating pedagogy 2014. Milton Keynes, UK: The Open University.

Sharples, M., de Roock , R., Ferguson, R., Gaved, M., Herodotou, C., Koh, E., Kukulska-Hulme, A., Looi, C-K, McAndrew, P., Rienties, B., Weller, M., Wong, L. H. (2016). Innovating Pedagogy 2016: Open University Innovation Report 5. Milton Keynes: The Open University

Sharples, M., McAndrew, P., Weller, M., Ferguson, R., FitzGerald, E., Hirst, T., and Gaved, M. (2013). Innovating Pedagogy 2013: Open University Innovation Report 2. Milton Keynes: The Open University.

Skaggs, P. (2018). Design Thinking: Empathy through Observation, Experience, and Inquiry. In E. Langran & J. Borup (Eds.), Proceedings of Society for Information Technology & Teacher Education International Conference (pp. 1168-1172). Washington, D.C., United States: Association for the Advancement of Computing in Education (AACE).

Sullivan, A. (2022).Trainee shortage adds to German workforce woes. Deutsche Welle. https://www.dw.com/en/trainee-shortage-adds-to-german-workforce-woes/a-62974599

von Thienen, J., Royalty, A., & Meinel, C. (2017). Design thinking in higher education: How students become dedicated creative problem solvers. In Handbook of research on creative problem-solving skill development in higher education (pp. 306–328). IGI Global.

Trust, T., Maloy, R. W., & Edwards, S. (2018). Learning through Making: Emerging and Expanding Designs for College Classes. TechTrends, 62(1), 19–28.

Valiente, O., & Scandurra, R. (2017). Challenges to the implementation of Dual apprenticenships in OECD Countries: a Literature review. Vocational education and training in times of economic crisis, 41-57.

Wright, G. & West, R. (2010). Using Design Thinking to Improve Student Innovation. In J. Sanchez & K. Zhang (Eds.), Proceedings of E-Learn 2010--World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education (pp. 391-395). Orlando, Florida, USA: Association for the Advancement of Computing in Education (AACE).

Wrigley, C., & Straker, K. (2017). Design thinking pedagogy: The educational design ladder. Innovations in Education and Teaching International, 54(4), 374-385.

Yin, R. K. (2009). Case study research: Design and methods. London, UK: SAGE Publications Ltd.