A Participatory Co-creation Model to Drive Community Engagement in Rural Indigenous Schools: A Case Study in Sarawak

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Abstract: This paper presents the formulated ‘play-to-engage’ model for indigenous community engagement that incorporates factors in cultural protocols and game design thinking. The hybrid model of the participatory co-creation model was formulated in the study that had been rolled out in two rural primary schools in West Borneo. These schools are located in remote villages, away from urban amenities, and technological affordances and resources are limited. There are more than twenty culturally-diversed indigenous tribes in Borneo. Although it is a known fact that indigenous cultures, including those in Borneo, have many cultural protocols and distinctive custom practices, it is still a challenge for researchers who work with such communities to understand, adhere to and follow the cultural protocols. The model looks at incorporating gameplay and culture protocols to drive community engagement. Since play is universal, the creation of a trustworthy partnership between the community and researchers was established through the use of play during the engagement process. Narratives captured in the study represented reflection, problem solving and creativity in the interactions with the indigenous communities, based on the developed indicators of the ‘play-to-engage’ model.

Keywords: play-to-engage, participatory co-creation, indigenous community engagement, culture

1. Introduction

Social research and intervention associated to the communities in Asia, in particular the indigenous rural communities, pose a challenge in terms of the need to be more empathetic and aware of the cultures that are very diverse, especially when the research and intervention approach is based on Western contexts. There is a need to be a more holistic and pragmatic pathway for ensuring that we are sensitive to the context of the communities in order to build trust and positive partnership.

One methodology to address the social inequity outsider researchers and indigenous peoples communities is the participatory action research (PAR). The participatory action research approach to community issues is a culturally relevant and empowering method for indigenous people in Canada and worldwide as it critiques the ongoing impact of colonisation, neocolonialism and the force of marginalisation (Severtson, Bauman, & Will, 2002). Participatory action research gives a voice to the oppressed and marginalised, and the methods and processes promote empowerment, inclusivity, and respect (Dickson & Green, 2001). Most importantly, this approach serves to deconstruct the Western positivist research paradigm that is, and has always been, antithetical to indigenous ways of coming to knowledge on many levels; theoretically, cognitively, practically, and spiritually (Haig-Brown & Dannenmann, 2000). PAR can, therefore, be quite significant to the inclusion of indigenous epistemology in the discourse of research.

Much of the literature about indigenous community engagement centres around the “connections between two bodies of critical scholarship - Eurocentrism and Whiteness (Madden, Higgins and Korteweg, 2013)”. Madden et al. addressed the nature of community engagement on indigenous communities in Borneo, where
they emphasised that community involvement requires new skills, new knowledge and new approaches to interpret narratives and situations within an indigenous community. There have been many undocumented cases where external actors often do not understand the indigenous community's customary protocols and governance systems because they are codified in ways specific to each community, culture, and location.

Failing to respect community protocols and customs, whether intentional or not, can lead to conflict, deterioration of otherwise constructive relations, and consequently negative impacts on the environment.

The article, therefore, provides insights into an action research, which was conducted around the engagement with such rural communities, centred around the use of playful approaches. Acknowledging that play is common to all cultures and is highly universal, we constructed a ‘play-to-engage’ model based on the concept of design thinking taking into account the specific cultural protocols and incorporating community empowerment indicators for indigenous schools and their respective villages. The direct output from the model is a participatory co-creation approach based on the ‘play-to-engage’ model to drive community engagement to guide researchers who are unfamiliar with indigenous communities and their unique cultural protocols.

As part of the co-creative process, the model integrates elements of game design and design thinking into an approach (i.e. in Arnab et al. (2017)’s Game Design Thinking) which enables the creation of new ideas and solving of complex problems. The benefit of design thinking for community engagement allows people to think and design their future, using their ingenuity and locally available resources (Burkett, 2016). Once the community is onboarded, practice building based on this co-creativity approach can be carried out. This model is relevant for other researchers and developers that will ensure positive engagement is achieved before any intervention can be implemented.

The article further elaborates on the ‘play-to-engage’ model, discussing its engagement pathway from onboarding through to co-creativity that supports learning. The onboarding process demonstrates the cultural protocol that involves getting the community onboard prior to engaging with the young people at the local schools. Section 3 discusses the constructed and identified indicators, and the outcomes of the engagement based on the indicators are analysed and presented in section 4. Finally, the results are concluded in section 5.

2. Play-to-Engage model – method and materials

This section discussed the engagement pathway underpinned by the ‘play-to-engage’ model implemented by the team associated to the Newton Funded CreativeCulture project (http://mycapsule.my) – a project that is aiming to introduce creative and playful pedagogy for teachers and learners in the rural Borneo. This project acknowledges the fact that rural communities around the world are marginalised due to lack of access to quality and also aligns with the emphasis on play as a key instrument for equipping young people with the skills to address and embrace the new realities of tomorrow (Brodin et al., 2019). Brodin et al. has also identified an alarming gap in play by gender and socio-economic factors for children across 70 countries, highlighting a strong link between play and the development of a range of skills children will need to flourish in the realities posed by Globalisation 4.0.

With these perspectives and contexts, the ‘play-to-engage’ model is informed by the playful Game Design Thinking, the communities themselves and their cultural protocols associated to the indigenous communities.

2.1 Game Design Thinking

Game design thinking is based on design thinking, where it involves the use of play and gameplay (Arnab et al. 2017) in the design process. We adopted game design thinking in the study to test how game elements can be integrated to enhance community engagement. Games use strategies and mechanics (how to play the game), teamwork (working together as a team) and problem management (how to solve the problems and to find innovative solutions). Applying game design thinking to our project led us to focus on understanding user’s point of view, and in the case of the study, the indigenous community.

Figure 1 presents game design thinking with play and games inspirations that consists of five main steps, namely Empathise, Define, Ideate, Prototype, and Test.
Exercising empathy means listening without any judgemental feeling to how others explain their problems. We added in the element of role-playing to engage, inform and build understanding, build relationship and teamwork and break the ice. Once the thoughts of the problems have been collected, the team defines the problems by thinking about the insights of the problems and issues and prioritising the problems. The problem management phase uses game strategies and mechanics to achieve a common goal (e.g. in-game on how to win or how to survive). Next step is to ideate the possible solutions by selecting some strategies and the mechanics of games. From one insight and choosing from the many possible solutions, prototyping the solution (as games) commences with the same team to create a tangible output. Finally, the output is tested and shared with others in the community.

2.2 The indigenous community and their Cultural Protocols

The idea to create the ‘play-to-engage’ model came when planning for community engagement with primary schools at Telok Melano and Long Lamai in Borneo Malaysia. These two rural schools are selected for their distinct differences, geographically and culturally. From the onset, the research team recognised that as part of the protocol, the need to communicate with the village dwellers the intentions of the study first, before pursuing the project location, which was the local school. The two communities are:

- Telok Melano is a traditional fishing village separated from the mainland of Sarawak by dense wildlife reserved forest and can be reached by boats over the South China Sea or at least eight-hour hike in the forest. The majority of Telok Melano residents are ethnic Malay. Since the Kalimantan Indonesia border is merely 20 minutes’ drive away, many Telok Melano residents have relatives on the Indonesian side, and several villagers also live across the border. The Telok Melano community is dependent on small scale fishing and farming for its livelihood. Only recently in late 2018, Telok Melano is connected by road to major towns in the state of Sarawak.
- Long Lamai is situated on the highlands, surrounded by dense rainforest, which is only accessible via a motorised canoe (or longboat) upriver or a few hours hike up a hill from the nearest village with a remote airfield. The Penan are the nomadic indigenous people settled in Long Lamai village, who survive by a rich culture of hunting and gathering. Long Lamai village was one of the earlier settlements, and due to its isolation geographically, the community of Long Lamai has established
an egalitarian system, i.e. a culture of deciding community consensus. Unity and solidarity have been mostly practised values among the Penan.

In both locations, the local primary schools are established within the villages. These primary schools are SK Telok Melano and SK Long Lamei. SK Telok Melano has 39 students, and SK Long Lamei has 65 students. The local children attend primary school from the ages of seven to twelve. Typically they would enrol in secondary schools away from their villages; however, there are cases of parents reluctant to send off their children to another location, hence depriving their children to access to higher education. School teachers at these schools are mainly from other townships and other parts of the country, often unfamiliar with the culture and needs of the community in the villages.

Researchers applied the cultural protocol in both schools in Long Lamai and Telok Melano. This cultural protocol was initially discussed and developed in Long Lamai by the community and UNIMAS researchers. The cultural protocols comprises of guidelines for community and researchers and are based the United Nations Declarations of Rights of Indigenous Peoples (UNDRIP). Most notable that was used the Free, Prior and Informed Consent Principles (FPIC).

2.3 The Model

Using Participatory Action Research (PAR) guidelines developed by Phoa (2009), we identified the elements of the ‘play-to-engage’ model. Narratives from meetings and informal discussions with community members and the schools enabled a constructive consolidation of local perspectives from the community in alignment with the study’s overarching goals. Community engagement is a dedicated process that requires a strong motivation to establish a mutual trust (Murphy, 2012), and such guidelines are useful to provide practical opportunities to all parties to articulate their needs. It is an important phase to determine onboarding, perceivable success and sustainability of the study within the indigenous communities.

In building the ‘play-to-engage’ model, we incorporated elements of action research, participatory evaluation and co-creation within the game design thinking to build a trustworthy partnership with the indigenous communities. There are two types of knowledge sets that we identified; one represents the knowledge owned and unique to the indigenous community, and one that is prescribed by the national curriculum, and presented to the children of the community through their local school. Within the communities, knowledge is shared through story-telling, demonstrations and play. Many games have been constructed to pass on knowledge of the elders to the young, and often the games are played in teams. At the local school, the national curricula are determined by mainstream philosophies and concepts, and there have been instances lamented by the children, teachers and their parents where the topic or idea presented is alien to them. In school, learning is designed by teachers to match the prescribed syllabus. The local teachers described how they occasionally use games in learning to break the usual tempo of the class. In the ‘play-to-engage’ model, we attempt to create a cohesive environment whereby it allows the researchers to shift from leading the study to also be a participant. Simultaneously researchers can help teachers to evolve from passive recipients into a continuum of andragogy and ultimately higher order heutagogical dimensions, where they were able to identify gaps in their learning and source methods conducive to their learning style to meet their learning needs (Smith, 2015). The playful approach is seen as an opportunity to enable co-creativity to occur deliberately, integrating knowledge from the community with those from the prescribed syllabus.

Figure 2 illustrates the co-creation approach in learning and how it fits together for productive playful learning in schools and outside school curricula. We proposed play as it is a universal language. Games could invoke positive emotional experiences (Lazarro, 2004), such as joy, optimism and pride in a person (McGonigal, 2011).

Games could also help to shift a community from negative to positive emotional experiences and to maintain a positive relationship. Gamification in school could also motivate students to participate more and change their concept as learners (Leblanc, 2006).
Figure 2: Co-creation in game design thinking for learning in indigenous communities in Sarawak

The idea of co-creation in game design thinking is the process of selecting ideas from the participants, in this case, they are the students and teachers, and then implementing the idea by building a prototype and testing the prototype. We also include the exploration of the creative practices, i.e. in problem-solving, and cooperative learning mechanisms, such as building trust within a group in the co-creation process.

Interestingly, in this study, we found that combining creativity, thinking and collaboration in co-creation have always been a challenge; however, in game design thinking, these processes flowed coherently. Figure 3 presents the modified and formulated ‘play-to-engage’ for schools. In the empathising stage, researchers are to identify schools and its community; conduct needs analysis, understand their custom, culture and protocols, share aims and purposes of the project, and get consents from the schools and community to conduct the project. A play day activity is conducted to gain access to the schools and also to identify champions. Understanding the students and teachers is vital before the define stage. Activities and specific actions are identified from the ‘play-to-engage’ activity day together as a team with the schools, and the students and teachers could learn from the researchers to further understand the shared purpose of the project. In the play day activities, we mixed the different core mechanics and strategies of local, commercial and traditional games into their learning. It is also known as the co-creation process. In the ideates stage, we then get the teachers and students to create and explore the remixed game-based learning content and the hybrid toolbox. Prototypes are developed for final showcase or re-remixed for further improvisation.

The model illustrates the stages to approach community onboarding. Typically in design thinking, engagement ceases to develop at the second phase, which is “Define”. However, in the study, engagement with the community and school continues to flourish even after the thinking cycle is completed. The iteration of co-creativity is developed through a series of planned interventions with the teachers and the communities.

2.4 How to Create Community Engagement in ‘play-to-engage’

We created several toolkits for engagement sessions with teachers and members of the community, to capture users’ points of view. These toolkits are designed with various aims and specific instructional steps.

From the onset, we maintained the same common language to talk and discuss elements of co-creativity. For example, we listed the types of games commonly played, and we brainstormed with teachers and local community members on the mechanics and strategies of the games. The narrative in these sessions and the co-creativity element to be understood, developed and deployed in the schools. A collection of remixed games are compiled online for future use and reference (further details in Playbox1). In general, games can be used for multiple purposes, especially for breaking the ice between people and energise bored participants.

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1 Playbox contains the collected remixed game for learning and remixed games can be found in http://playbox.mycapsule.my
Remixed games add in an extra dimension to the participant engagement as these games include collaborative problem solving and learning. The ‘play-to-engage’ model can involve facilitators and participants in design discussions. Here, the researchers play the role as facilitators. The engagement experience is shared through the design construction process. Participants’ experiences in playing games, understanding the mechanics and strategies of the games, and sharing with others, recreating new games from the different game mechanics, building prototypes and testing them with other participants, were illustrating the value of engagement.

Figure 3: The ‘play-to-engage’ model
3. Evaluation methods

3.1 Indicators of the Community Engagement in ‘play-to-engage’ Model

Community engagement in schools consists of both behavioural and emotional engagement dimensions. Behaviour engagement is defined as observable behavioural characteristics based on the effort dedicated to an activity or learning and the level of achievements. Emotional engagement can be captured based on their cultural values, interest and enthusiasm. Behavioural factor (also known as participation) is an active attitude towards learning activities. Emotional factor (co-creation) is the involvements of students and teachers, and the sense of belonging to the learning community. Here, participants will invest their thoughts, mental efforts and learning strategies to achieve learning tasks by solving problems, collaborating and cooperating. These behavioural factors and emotional factors make the participatory co-creation model. In this model, we employ the ‘play-to-engage’ model to conduct community engagement in schools.

The indicators of the ‘play-to-engage’ model through narratives captured and formulated during community engagement are presented in Table 1.

Table 1: The Developed Indicators for Community Engagement in Indigenous Communities and Their Schools

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture</td>
<td>• Able to work with people of different ethnicity and race, religious belief</td>
</tr>
<tr>
<td></td>
<td>• Able to work with people of different levels and professional groups</td>
</tr>
<tr>
<td></td>
<td>• Able to work with people of different age</td>
</tr>
<tr>
<td></td>
<td>• Understand their cultural values and belief</td>
</tr>
<tr>
<td></td>
<td>• Cultural and tradition continuity</td>
</tr>
<tr>
<td></td>
<td>• Utilising local wisdom and knowledge</td>
</tr>
<tr>
<td>Learning</td>
<td>• Combine ideas, game mechanics to practical problems or new situations</td>
</tr>
<tr>
<td></td>
<td>• Connect ideas</td>
</tr>
<tr>
<td></td>
<td>• Analyse and connect ideas and games to problems and solutions</td>
</tr>
<tr>
<td>Participation</td>
<td>• Interact with people</td>
</tr>
<tr>
<td></td>
<td>• Frequently interacting with other team members</td>
</tr>
<tr>
<td></td>
<td>• Build confidence in the group</td>
</tr>
<tr>
<td></td>
<td>• Expression of opinions</td>
</tr>
<tr>
<td></td>
<td>• Community activity management</td>
</tr>
<tr>
<td>Collaboration</td>
<td>• Work together for a common purpose to solve problems</td>
</tr>
<tr>
<td></td>
<td>• Produce solutions</td>
</tr>
<tr>
<td>Cooperation</td>
<td>• Request help</td>
</tr>
<tr>
<td></td>
<td>• Work together to solve problems</td>
</tr>
<tr>
<td></td>
<td>• Understand someone else’s views, ideas</td>
</tr>
<tr>
<td>Questioning</td>
<td>• Correspond to questions</td>
</tr>
<tr>
<td></td>
<td>• Ask relevant questions</td>
</tr>
<tr>
<td>Fun</td>
<td>• Enjoyment</td>
</tr>
<tr>
<td></td>
<td>• Informal experience of enjoyment of pleasure</td>
</tr>
<tr>
<td></td>
<td>• Play activity</td>
</tr>
<tr>
<td></td>
<td>• Creativity</td>
</tr>
<tr>
<td>Organisation and social</td>
<td>• Encourage the team to participates and be involved socially</td>
</tr>
<tr>
<td>environment</td>
<td>• Connect with all team members</td>
</tr>
<tr>
<td></td>
<td>• Motivated</td>
</tr>
<tr>
<td></td>
<td>• Social relationship and relationship with researchers</td>
</tr>
<tr>
<td></td>
<td>• Community leadership</td>
</tr>
<tr>
<td></td>
<td>• Organisation of the community</td>
</tr>
</tbody>
</table>
These engagement indicators are identified from the observation of actions, non-verbal communication, feedbacks and evidence of emotions. They were also analysed and formulated from the existing student engagement (Helme and Clarke, 2001) and the community empowerment indicators. The outcomes and feedback from the engagement sessions are recorded and categorised accordingly.

3.2 Measurements of the Community Engagement in the Participatory Co-Creation Workshops

It is important to highlight that community engagement is a process, as well as, an outcome (Palmer-Wackerly et al., 2014), meaning that it produces results and ideas that are emergent and co-owned by the community (schools) and therefore sustainable over time. At present, there is no way to measure the design thinking outcome (Schmiedgen et al., 2016), which we used as the basis for community engagement. However, several criteria can be used to build a measurement framework. The mix of measures that is useful, including:

- Feedback: the feedback from the participants to determine the level of satisfaction based on their testimonials after each of the workshops.
- Co-creation activities: the number of co-creation activities and participants in it.
- Remixed play tangible games and products: the number of created remixed play tangible products from the co-creation activities.
- Working culture: the impact of co-creation measured factors such as motivation, change of behaviours, team collaboration and engagement.
- Reflective measurements: questionnaires, surveys, interview internally by participants.
- Relationship and communication: is there a continuous communication between the schools and researchers during and after the project? The trustworthy partnership between the community and the researchers.
- Replicability: can this play-to-engage approach be used and implemented to other projects?

The use of the Free, Prior and Informed Consent certificate helped researchers to understand their roles and responsibilities from the start of the project. Using game design thinking, we organised remixed play activities with both the communities and their local schools. As community engagement is seen as a continuum of community involvement, the continuous engagement aims to collect local knowledge, issues and motivations from the local schools and communities.

4. Findings and Discussions

4.1 Engagement with the Communities

The aim of the engagement is to present the CreativeCulture project to the communities. The findings presented here are based on the play and games activities with communities to strengthened the researchers’ partnership with the communities. The playday was run for approximately 4-5 hours together with these indigenous communities, to get people in an open, playful, and moderately risk-taking frame of mind, psychically warm them up. In addition to the activity, the research team has collect and better understand the core mechanics and strategies in their local games, and stories behind each game.

In looking at the participation during the play day activities, all the indicators in Table 1 are exemplified during the play day activity with the village head and community of elders during community engagement. The community, including the elders and the village head, organised and each of them came and participated the Playday (indicator: organisation and social environment). Both groups, the research team and the community, were learning from one another to understand the culture, community, their local games, the story behind the games, and we also challenged them to think of ways that we can use the games for learning in schools (indicator: learning, culture, questioning). There was a positive interaction and good bond during the participation (indicator: participation). We collaborated and cooperate to win the game, and to improve the strategies to winning the game (indicator: collaborate, cooperate, questioning). Everyone had a good laugh and fun during the Playday (indicator: fun).

The Playday has indeed strengthened a positive relationship between the researchers and the indigenous communities and their local school communities.
4.2 Indicators of Engagement in Schools

We conducted engagement with the two rural schools to present the CreativeCulture project. We have applied participatory co-creation. In the beginning, we showcased some of the games that were remixed, created and developed by the Computer-Supported Collaborative Learning (CSCL) students from the previous activities for the teachers and students to play (details of the remixed games can be found in Mohamad et al. (2018)). The next session on different days, we conducted the ‘play-to-engage’ approach with the teachers and students.

The teachers also shared and discussed their concerns and interest, and these indicators correspond to the developed indicators. Each of the indicator will be further described and the findings from the engagement activities are exemplified in Table 2.

Table 2: Indicators and Findings from the Participatory Co-creation Engagement

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Culture</td>
<td>I have friends of different ethnicity and religious belief.</td>
</tr>
<tr>
<td></td>
<td>I know my belief and my culture.</td>
</tr>
<tr>
<td></td>
<td>I would utilise the knowledge I learnt from my family and use it in school.</td>
</tr>
<tr>
<td></td>
<td>I want to be like my father, to be a fisherman.</td>
</tr>
<tr>
<td></td>
<td>The headmaster is also involved in the activities with the teachers and students.</td>
</tr>
<tr>
<td></td>
<td>I am able to express my concerns, issues and problems.</td>
</tr>
<tr>
<td></td>
<td>The learning aspects have included cultural traits from the community.</td>
</tr>
<tr>
<td></td>
<td>Give exposure to these rural students.</td>
</tr>
<tr>
<td>Learning</td>
<td>I try to approach the activity with a new perspective.</td>
</tr>
<tr>
<td></td>
<td>I am motivated to learn when there is game.</td>
</tr>
<tr>
<td></td>
<td>I am share my ideas without being judged.</td>
</tr>
<tr>
<td></td>
<td>When I grow up, I want to be …</td>
</tr>
<tr>
<td></td>
<td>I learn to make my own games.</td>
</tr>
<tr>
<td></td>
<td>Playing games to learn is easy.</td>
</tr>
<tr>
<td></td>
<td>I could relate what I have learnt in school.</td>
</tr>
<tr>
<td></td>
<td>Can I use games for teaching?</td>
</tr>
<tr>
<td></td>
<td>I improve my teaching?</td>
</tr>
<tr>
<td></td>
<td>I use a new approach to teach.</td>
</tr>
<tr>
<td></td>
<td>I enjoy using games to learn because I want to be smart.</td>
</tr>
<tr>
<td>Participation</td>
<td>I will try answer the questions other students ask.</td>
</tr>
<tr>
<td></td>
<td>I am more confident to speak.</td>
</tr>
<tr>
<td></td>
<td>I am more daring to act.</td>
</tr>
<tr>
<td></td>
<td>I can speak up.</td>
</tr>
<tr>
<td></td>
<td>I observed that the students have gained confidence in learning.</td>
</tr>
<tr>
<td>Collaboration</td>
<td>I try to work together with other students to solve a problem.</td>
</tr>
<tr>
<td></td>
<td>I try to find ways to win the game.</td>
</tr>
<tr>
<td></td>
<td>I work together with other students to win the game.</td>
</tr>
<tr>
<td></td>
<td>It is easy to approach to the teachers to solve problems.</td>
</tr>
<tr>
<td>Cooperation</td>
<td>I could improve my communication skills.</td>
</tr>
<tr>
<td></td>
<td>I learn to listen.</td>
</tr>
<tr>
<td></td>
<td>I would ask for help.</td>
</tr>
<tr>
<td>Questioning</td>
<td>I ask question when I do not understand.</td>
</tr>
<tr>
<td></td>
<td>I learn to ask questions.</td>
</tr>
</tbody>
</table>
4.3 Reflection on the Approach: Participatory Co-creation in Rural Schools

Applying the participatory co-creation approach in rural schools gave us the following insights.

A major success factor in the implementation of rural projects is the process of community engagement where community leaders and members of the community, including parents and teachers become in partnerships with one another, as well as, with the researchers. It is seen that the ‘play-to-engage’ activities in schools have invoke positive emotional experiences, and we have built strong relationship with the schools and the communities. In addition, teachers are more motivated to create learning games that they can use in their classrooms and the students were having fun while learning.

One of the comment from the teacher after the activity - “I think this co-creation activity is tremendously helpful in brainstorming ideas to design and create game activities which are suitable for our students. Besides that, we as teachers can share those ideas in creating activities which are fun and yet meaningful. From my observation, our senior teachers, who are usually passive in contributing ideas, had eagerly participated to come up with ideas for the new games and even tested it with students. Also, I witnessed how some usually passive students in the class had become leaders in their groups by coming up with ideas and implementing them in the game creation. These playful game activities seem to trigger their passion and feelings towards knowledge, which is not normally seen in a classical classroom setting. As a teacher, I want to thank all of your team members, who came to our school and helped to share new ideas and technologies with our students and teachers as well. The CreativeCulture initiative has successfully refreshed and renewed the student's interest in gaining knowledge via game-based learning activities.” – teacher from SK Long Lamei.

This comment reaffirm the importance of gameplay in engagement and indeed, it could invoke positive emotional experiences and could motivate teachers and students to participate more and change their concept as learners.

5. Conclusion

The need for a playful protocol to aid engagement that is sympathetic to the local context has led to the development of a ‘play-to-engage’ model that was inspired by game design thinking that formulates the engagement pathway and processes with the indigenous community. The approach facilitated the engagement process between the communities and researchers.

One of the main strengths of game design thinking is the element of empathy. Empathy involves observing, engaging and empathising with stakeholders to better understand their experiences, issues or problems, needs and cultural protocols or customs in a community. Indigenous peoples have unique customs, protocols, procedures, rules, and regulations that regulate their everyday interactions within and between communities and with the resources and the natural surroundings.

From the onset, the research team recognised the need to communicate with the village dwellers the intentions of the study first, before pursuing the project location, which was the local school. Acknowledging that play is universal, gameplaying were used in the initial engagement process with the community. The
approach helped ease partnership brokering between the researchers and community members, as well as the introduction of the project to the community.

In summary, the presented novel indicators for the ‘play-to-engage’ method have been discussed and the qualitative results were presented. The potential venues for future works will be utilising content analysis to explore the indicators used in this method, and to measure the correlation of the indicators.

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Co-Creativity through Play and Game Design Thinking

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Abstract: This article discusses the application of game design thinking as a learning process for scaffolding co-creativity in Higher Education based on the GameChangers initiative (gamify.org.uk) part-funded by the Higher Education Funding Council of England (HEFCE). Taking into account the relationship between play, technology and learning, the game design thinking approach fully embraces and accommodates for the creation and development of games of any typology (board games, card games, digital games, etc.) and playful solutions (gamified products) as freely chosen by the learners, aligning with the importance of autonomy, relatedness and purpose in motivating learners to be deeply engaged in the process. Through this process, learners are expected to gain valuable knowledge in creative and collaborative problem solving and experience game design and development process towards addressing real challenges and opportunities in their communities. The focus of the process is on the creative process rather than the end products/solutions produced by the learners. The paper will specifically discuss the methodology and findings from an experimental module developed based on the approach involving four cohorts of Level two undergraduate students (n=122, 2017-2019). The students came from the different schools and faculties at Coventry University, UK. Based on the qualitative feedback and reflections collected through the Module Evaluation Questionnaire (MEQ) and the final reflection pieces, the co-creative process inspired by play and games demonstrates that through the process, students discover the importance of elements such as empathy, purpose, meaning, art, creativity and teamwork in their learning regardless of the specific disciplines they are pursuing.

Keywords: co-creativity, playful learning, game-based learning, game design, higher education

1. Introduction

Games, digital or analogue, are increasingly applied for educational, training, and research purposes. Since the mid-1980s, various applied games have been developed, and the application of digital games to support pedagogical goals often seeks to capitalise on growing trends amongst a wide range of target audiences to engage with digital media recreationally. There is also a huge potential for a gameful design to drive social participation and action in the community. The use of game thinking in this sense is expanding the potential for game-based approaches for impacting the society through its very design to engage individuals in serious topics and challenges in their community.

Games are an increasingly culturally relevant form of aesthetic and artistic expression, where they are creative systems that enable play and exploration. Engaging in the creation of a playful system can literate citizenship to not only achieve a higher understanding of complex dynamics across science and society, but to envision, design and act upon creative alternatives. As game designer and scholar Zimmerman (2008) suggests, “being able to successfully understand, navigate, modify, and design systems will become more and more inextricably linked with how we learn, work, play, and live as engaged world citizens.” (pp. 25)

Creativity, problem solving, critical thinking and team working have been highlighted as skills for employment expected in 2020 (World Economic Forum, 2016). Designing and creating gameful systems, as an activity on the edge of the diverse fields of Art, Design, Science, Computation and Engineering can be a fertile ground to cultivate such competencies through multi-disciplinary collaboration, providing a playful (engaging), creative and innovative space for people to meet and learn how to fruitfully cooperate.

Inspired by the opportunities for innovative practices enabled by playful co-creativity, this paper specifically focuses on the GameChangers programme (http://gamify.org.uk) that is promoting the application of game design thinking (Arnab, et al. 2017) as an instrument for encouraging learners to understand, apply, test and reflect knowledge in higher education. Findings and insights from an experimental module developed under the GameChangers programme involving three cohorts of Level two undergraduate students (n=90) from the different schools and faculties at Coventry University, UK are discussed. Section 2 will briefly touch on related background in co-creativity and game design thinking, followed by a description of the GameChangers
approach and the research methodology in Section 3. Section 4 will discuss the findings from the experimental module developed under the GameChangers programme and the article is concluded in section 5.

2. Background

While the formal context of a classroom is considered to be a primary location of learning, a majority of student learning activity takes place outside the classroom, where social interaction is a growing part of learning. With this perspective, pedagogy is also shifting, emphasising on active, creative and collaborative learning. Relying more on hands-on activities, classrooms are starting to mirror “real-world work and social environments that foster organic interactions and cross-disciplinary problem-solving” (NMC Horizon Report, 2018 page 4).

To support the shift in pedagogy, there is value in exploiting a design process as a non-linear, iterative and incremental process, which is generative and creative, allowing us to take a complex problem, understand what the problem is and develop possible solutions. Design thinking (Plattner, 2011) as an approach has crossed over to learning, where it is a “way of finding human needs and creating new solutions using the tools and mindsets of design practitioners” (Kelley & Kelley, 2013, pp. 24-25).

Design thinking is a way to structure an iterative design process, and demonstrates how it is possible to frame a problem so that it is understandable and easy to confront. It uses the idea of creating a product, with an explicit process of brainstorming, finding out the needs of the audience, design, development, testing, sharing, and more. Such a creative and hands-on process can help students and educators break out of the typical classroom model and showcase what learners can achieve. It is a place for students to use different problem-solving styles, to add their own flair to assignments, and to think about the impact they could have on the world.

Capitalising on core motivational drivers, such as autonomy, relatedness, purpose and competence (Ryan & Deci, 2017), the holistic approach of solving problems by using the design thinking approach could motivating learners to engage with the creative and co-creative process through self-discovery (Reiss, 2002). Learners will be able to discover different solutions in a creative way, which can open up new opportunities for them to engage with meaningful learning experiences that can translate into more sustainable practices in the real world. Purpose can be seen as our need for there to be meaning to our actions. Autonomy refers to self-organising and regulation of one’s own behaviour, which includes “the tendency toward inner coherence and integration among regulatory demands and goals” (Deci & Ryan, 2000; p. 252). Relatedness refers to “feeling connected to others, to caring for and being cared for by those others, to having a sense of belongingness both with other individuals and with one’s community” (Deci & Ryan, 2004; p. 7). Competence in this case refers to seeking the pleasure of being effective in what they engage themselves into. The need for competence would lead individuals to “seek challenges that are optimal for their capacities and to persistently attempt to maintain and enhance those skills and capacities through activity” (Deci & Ryan, 2004; p. 7).

Education and industry have only very recently started tapping into such huge wells of creativity and cooperation expressed by the diverse manifestations of informal learning spaces which are built around cooperation and design thinking. A key factor in this shift toward a more democratic appropriation of design and computation is the potential for cooperative, community based learning of FabLabs, Hackerspaces and Makerspaces, which, as highlighted by the European Commission report “Growing A Digital Social Innovation Ecosystem for Europe” (EU Comission, 2015a), can become hotbeds of innovation. The report goes on suggesting how cities and governments could further increase the potential for digital and social innovation by investing in some of the spaces and developer communities from where innovation often emerges, such as makerspaces, FabLabs and hackerspaces.

There are also a massive number and growing cultural relevance of the “Game Jam Movement” (see among others; studies carried out by Fowler et al. (2013) about the opportunities game jams offer for rethinking teaching and learning and Locke et al. (2015) for the Movement’s disruptive impact on industry practices), being only one of the examples, where almost seven thousand games developed in 48 hours during the 2016 edition of the Global Game Jam, or the 15 Jams organised by the JamToday network to promote healthier lifestyles.
Games (digital, analogue or hybrid), given their inherently systems-based nature, constitute a powerful path toward actively experiencing systems science and thinking, and creating games or creating solutions inspired by game elements constitutes an invaluable opportunity to get acquainted in a proactive way with the fundamentals of this paradigm (among others: feedback, causal loops, synergy, homeostasis emergence). Game design and making is emphasized as pathway to STEM learning by existing initiatives, such as the Annual National STEM Video Game Challenge in NYC (http://stemchallenge.org) aiming at combining creativity and STEM Skills through video game design. Chiarello and Castellano (2017) also exploit the process of game design for promoting STEM education.

Games Design has also been emphasized as an extremely useful context for developing digital creativity (Nesta, 2013), where designing systems and understanding human behaviour that draws on concepts fundamental to computing (Wing, 2006; Mozelius & Olsson, 2017). Games present worlds with defined rules, clear objectives and often more than one possible solution to a problem, which enhances the context of both design and computational thinking. Designing, developing and playing games deepen content knowledge, strengthen collaborative skills, combine arts and technology, and build appreciation for the talents of others. The critical thinking skills developed through the process of game design become internalized (Lippl, 2015).

"Innovative new ideas and creative solutions often emerge at the interface between disciplines and involve different societal actors... Linking the arts and humanities with science, technology, engineering and mathematics brings the scientist, engineer, entrepreneur, artist and designer into dialogue to offer the widest range of opportunity and academic and societal insight for experimentation and innovation..." (EU commission, 2015b, p. 20). Successful learning in the 21st century, depends both on networked, horizontal connectedness across a plurality of areas of knowledge and on the communities, which embody this knowledge, be it on a local or a global level.

Moreover, there is a huge potential for a co-creative process through play and games design to drive social innovation in the community. Existing initiatives, such as the Playable City (https://www.playablecity.com/) engages the community towards repurposing existing infrastructures in the city and designing playful activities that addresses urban challenges. Uncharted Power (https://www.u-pwr.co/), a social enterprise is founded based on the Uncharted Play initiative that explored and exploited play and games for developing energy solutions. Games can be "considered a productive method for fostering civic learning, both within formal and informal situations" (Gordon & Schirra, 2013).

Through the process of game design and design thinking, we can link the arts and humanities with science, technology, engineering and mathematics, which will bring the scientist, engineer, entrepreneur, artist and designer into dialogue to offer the widest range of opportunity and academic and societal insight for experimentation and innovation. This opens up opportunity for such a process to be adopted and adapted in education that will enhance and enrich the creative and collaborative learning agenda.

3. Methods and materials

Inspired by the game design and design thinking approaches as a means for scaffolding multi-disciplinarity, creativity and collaboration, the research has been designed based on the GameChangers programme (Arnab et al., 2017). The programme is an experiential learning programme grounded in constructionist pedagogy (see Ackermann, 2004) that facilitates new models of teaching and learning, and new practice in cross-context learning (in/formal) through the use of game design thinking for creative problem solving - highlighting the importance of activity based approaches and hybrid spaces. Figure 1 illustrates the design thinking process as adapted by the GameChangers programme with a focus on game design.

The programme’s key stages and missions (M) are:

- **M1 Set the stage and unpack (What do we care about?)** - understanding the problems or topics to be addressed during the programme. (Onboarding and Discovery stage)
- **M2 Ideation and innovation sketches (What can we do?)** - designing possible solutions to a problem at hand, or ways to creatively express a community’s particular interests. (Discovery stage)
M3 Enabling technologies and solution selection (How can we do it?) - exploring options in enabling tools and technologies, test the tools and consolidate ideas in an iterative way to select the best solution to develop in the programme. (Enthuse stage)

M4 Mock-ups and Prototyping (How can we make it work?) - developing ideas into working products and mock-ups. (Enthuse stage)

M5 Testing and reflection (Where do we go now?) - testing the prototypes, iterating on the design and reflecting on the learning process and the potential of the outcomes for further development. (Mastery Stage)

Figure 1: GameChangers’ Game Design Thinking approach

A formal undergraduate module on game design thinking (Level 2, 100 study hours, 10 CATS points) has been developed as a research instrument, part of the GameChangers programme and supported by the Higher Education Funding Council for England (HEFCE). This module, which is formally called Playful Design Thinking guides students to apply a playful approach to design thinking inspired by a game design process, which involves solving real world problems with practical, fun and engaging solutions – for example, building a reward/feedback-based game into the act of recycling to encourage sustainable behaviours, redesigning football that could harness energy from rotation, using posters to collect responses on humorous quizzes across the city to encourage the general public to place their chewing gums on the poster instead of throwing them on the floor, etc.

Students reflect on and apply playful design thinking mind-sets, skills and processes to problem-solving and creative thinking for the 21st Century workplace. At the end of the module, students come up with their own playful solutions (e.g. digital or non-digital game-based products) to the selected problems/opportunities and reflect on the design process. Students complete a presentation and submit the reflection on their experiences of the playful design process and the solution they have designed. The design thinking process as illustrated in figure 1 was spread across the 10 weeks, with a focus on M4 and M5 from week 8 to week 10.

One hundred and Twenty Two (n=122) participants at Undergraduate level 2, have been involved in the Playful Design Thinking module that has so far run over the course of four academic terms consisting of four cohorts (with roughly 30 students each to a cohort – Cohorts 1A, 1B, 2A and 2B). These modules ran between September 2017 to April 2019 and took place for 2 hours every Tuesday evening for a maximum of 10 weeks.

Being an elective module offered as an open option to students attending all University’s faculties and schools, participants were found to be from different disciplinary backgrounds, such as Engineering, Computing, Arts and Humanities, Business and Law, and the Health and Life Sciences. In each cohort, there was a good mix of different disciplines. Participants were tasked to work in teams and produce a digital and/or non-digital
application which were to be playful and/or gameful in nature and to respond to the challenges that they identify as a group (see Figures 2, 3 and 5).

Figure 2: Lights out – a gamified product for managing noise pollution

Figure 3: Shutoff Showdown- Board game concept for teaching children about energy consumption around the house
The interdisciplinary aspect of the module is particularly relevant, in that it made it both harder and much more interesting for people to generate ideas and prototypes across disciplines. An emphasis on co-creation in the course, that is on the necessity of working together across sectors and with intended users, was therefore at the core of the activities, of the theoretical contents and of the ethos. Students were encouraged to come together in groups to select a relevant issue (e.g. sustainability, health, inclusion), ideate a basic solution,
prototype it and actively engage with prospective users outside of the classroom to iterate a final, co-designed product.

Qualitative data from the official Module Evaluation Questionnaires (MEQ) and Week 10 reflective piece (written submission) were collected. The MEQ for the first cohort was collected in Week 5. Based on the findings of the first cohort, the module decided to collect the MEQ in week 10 at the same time as the reflective pieces. The MEQ for the later cohorts matched the reflective pieces; therefore, the findings from the first cohort will be considered to be signification as part of the discussions in this article. Aside from this structured data gathering, module tutors were, throughout the module, attentive to the climate and discussions in the classroom, complementing the aforementioned questionnaires with qualitative observations. This second layer of data gathering and discussion enabled us to contextualise the outcomes of the questionnaires, and explore their implications and the emerging theme informally but with greater depth. The qualitative feedback was analysed and categorised into themes and they are discussed in the following sections.

4. Discussions

4.1 From confusion to ‘light bulb’ moments

When the module was first run, we discovered that divergent thinking related to innovative practices was observed to be a huge challenge for the participants who were not familiar with the concept of game design thinking as an approach. Based on classroom observations and discussions, and on the MEQ feedback taken in Week 5 of the first cohort term, the majority of the students found that the module was ‘interesting’ however, assessment was a key barrier for their understanding. Students particularly displayed concerns on how assessment would be conducted.

“At the start of this module, I was very confused as to what we will be doing, unsure about what the end goal is...” – Cohort 1A – Student A

“I don’t know what I have done for this module” – Cohort 1A Student B

“Clearer advice about how it is marked...”. – Cohort 1A Student C

It was clear from the feedback that further refinement and guidance was needed, particularly to support those students who were not from traditional design and arts-based disciplines, around what was expected from them for the modules assessment criteria.

Another issue that was observed in this first cohort was that some students focussed mainly on developing the end product rather than engaging in the learning process itself. It was clear that they were not able to quickly or easily grasp the “outside-of-the-box” nature of the process, and this proved challenging for a large number of the cohort. However, as a whole, the students in the first cohort (1A) recognised that the module was different from what they were used to and appreciated the “relaxed atmosphere” with some students even feeding back that they enjoyed the challenging aspect of the course.

“it’s different, interesting to see how work and play go hand in hand,” – Cohort 1A Student D

“mentally stimulating and helps see games from a different angle...” – Cohort 1A Student E

To address and dispel student confusion and misunderstanding over assessment and the learning materials, the module was refined to coincide with the new term and Cohort 1B. This included a strip-back of some of the learning content to match expectations and align more effectively with a 10-credit module taken at Undergraduate level 2. This was found to be successful with the return of cohort 1B’s (as well as the later cohort’s) MEQ feedback, in which we saw a shift from confusion about the course to students requesting more supporting materials in an online capacity.

4.2 Serious fun

Whilst play is often seen as a non-serious endeavour and without greater purpose in higher education, the module actively sought to challenge this assumption by engaging students in playful activities to push
boundaries in how they conceptualised fun and play in the world. Through the playful design thinking process, 
the students discovered that fun can have serious and positive consequences and were challenged to innovate 
on how we deal with real world problems through a playful approach. The students acknowledged through 
their feedback that getting inspirations from playful activities helped the learning to be more engaging and 
contextualised.

“I have learnt that learning can be fun! Who would have thought?” – Cohort 1A Student E

An interesting element that was found from the feedback, was that students felt that this module was where 
they had experienced ‘fun’ through learning, but indicated that this was either for the first time or that it was 
rare for them to feel this way. This has led to deeper questioning about why they had not experienced ‘fun’ at 
other points in their learning at University and if so, then why not? Following on from this, another student 
recognised that;

“it was more memorable when I was learning through playing”. – Cohort 1B Student A

The student connects the idea that memory of ideas can come from play, and that play has been a key 
element to help retention of new knowledge. This allows us to summarise that the importance of play is not 
just theorised on as a part of the process of design thinking as a concept, but is utilised as a practical element 
of the learning about design thinking itself. The module was designed to be experimental in its approach, 
putting play at the forefront of the approach and delivery of the module which has been shown through 
student feedback across the four cohorts to have been a popular engagement tactic.

“It’s creative and a good change from my modules. Something to look forward to.” – Cohort 2B 
Student D

4.3 Empathy

One of the most frequently commented on aspects of the module across all four cohorts was the use of 
‘Empathy’ in the design process. Using play and games as inspirations for achieving social innovation was 
fundamental in allowing students to engage with real challenges/topics and the needs of their target audience.

This was reflected upon and designed into the modules core learning activities. Students were first exposed to 
existing examples of how social innovation can change behaviour/ impact knowledge & awareness in a more 
intrinsic way, so that they could identify how play and games could be used at the heart of the design process.

The students were shown through play and games on how we can exploit this to foster intrinsic motivation in 
tended stakeholders for developing positive and intended outcomes. The process allowed them to discover 
the value of “empathy” in everything that they do.

Students reported that understanding about the use of ‘empathy’ in the design process was a new skill that 
they gained directly from the module and was a skill that they could use and apply elsewhere.

“the empathy at the core of it will be another useful skill to have in not only the line of work I want to 
achieve, but in everyday life and social situations...” – Cohort 2B Student B

“...appreciation of different mind-sets and skillsets...” – Cohort 2B Student C

Some students also linked and identified these skills as ones that had not been practised or gained from their 
main course work.

“...being imaginative and empathetic would greatly help what I am missing from my course...”. – 
Cohort 1A Student C

As the study did not track the individual background disciplines that the students came from in regards to 
feedback, it is difficult to say from which area this was felt to be missed. Although one student indicated that 
being from a ‘computer science’ background, meant that ‘usability’ was not usually considered a priority.
“What I’ve learned from studying this module is that when thinking about gamifying a problem such our case (concerning stairs), we need to be able to emphasise with our core audience and see from their perspective. As someone who is a computer science student, we, approach things very technically and we don’t see usability as a priority.” – Cohort 2A Student C

“doing engineering causes one to become more reliant on maths than creativity. Because of this, designing new learning experiences, where the focus is being imaginative and empathetic would greatly help the hole I am missing from my course.” – Cohort 2B Student B

Future work will look to track this information to provide a better understanding on any discrepancies between the disciplines on perceived skills gained in relation to ‘empathy’ and ‘usability’.

Further student feedback In relation to empathy, indicated that the students seemed to really engage with the process of speaking to, and receiving feedback from end users and stakeholder groups as part of their design and development process.

“The feedback from people was incredibly helpful as it aids our progress to be greater. We treat our classmates and lecturers as our client, therefore, we “listen” to their feedbacks and took it into consideration. We basically solved the puzzles with the help of many others thus without them, we would probably be struggling still.” - Cohort 2B Student A

“I learned that empathy is very important for us as designers and particularly for design thinkers because it allows us to uncover and truly understand the latent needs and emotions of the people we are designing for. This allows us to really emotionally understand just why and how the product needs to be for others to engage with it, not just to target the issue.” Cohort 2B Student F

“Through researching into the curriculum, I contacted a teacher within Coventry, we found that although the curriculum does begin to cover the topics of energy consumption and the effects on the environment, it is not as effective as it could be, as the children learning about the topic find it interesting but learn about it best when its taught in an age appropriate way.” – Cohort 2B Student B

Students also linked this process back to understanding that initial pre-conceived ideas and thoughts about an issue without end-user input, can be limiting as a creator.

“I learnt if you don’t have a target market you have nothing to focus on, apart from what you want as the creator.” Cohort 2B Student D

“This enabled me to find more meaningful solutions as caring and understanding primarily about a different user allows you to create ideas directly aiding others issues.” – Cohort 2B Student C

“Empathizing before defining the issue I found opens your mind to more potential outcomes as you have already had relative insight on your problem and a greater desire to fix the issue now because of it. Defining the problem now enables you target more specific aspects within the issue.” - Cohort 2B Student C

Whilst this step of the playful design thinking process was fed back upon as a positive experience for the majority of students, one indicated that they found it difficult to identify with the ‘user needs’.

“I personally found it hard to bond with user needs, as I’m also very sporty I couldn’t empathize from a lazy point of view making this one of the more difficult stages for me, it has awoken perspective thinking, putting my feet in someone else’s shoes as it were.” – Cohort 2A Student B

Ensuring that students are supported through this step is key to helping guide them through the understanding of its importance to the design process. In the module, a range of playful techniques were employed, including that of Lego Serious Play (LSP), so that students could practice opening up and sharing in front of each other. Further work following this feedback will look to grow this area, so that students are given
the correct support to feel confident in approaching, and working with stakeholder user groups in the ‘empathy’ stage of their design process.

4.4 Purpose and meaning

Students recognised in their feedback that the element of ‘fun’ alongside empathising with the target audience can play an important role in creating meaningful outcomes. Through the creation of playful activities, the students recognised opportunities to carefully develop experiences that stakeholders could engage with. Most importantly what has come through the feedback across the four cohorts, is that the students recognise that they need to consider purpose and meaning in their creations and designs moving forward for their future careers and endeavours.

“...I have learnt a lot about creating something with purpose beyond initial function, developing an experience rather than a product” – Cohort 1B Student F

“I wanted to see my creation spread my message... reach other people through an engaging platform, and hopefully leave a mark inside them” – Cohort 2A Student E

“...games can be adapted so others could learn, be more ethical, or change a real-world issue to be solved...” – Cohort 1A Student B

“knowing you can create something to help others is very rewarding”. – Cohort 2B Student C

It is this realisation from the students that we believe the module has provided a successful example of how teaching playful design thinking can lead to a deeper understanding of meaningful design taught at University Undergraduate level.

4.5 The Creative Process and Games as an Art Form

Throughout the module, students are actively taken through the creative process of formulating new ideas and concepts, and are actively encouraged to play around and push boundaries of what they know and believe. Creativity is a top desirable skill in prospective employees, and is a relative skill that can be applied to any discipline. Some students’ reflections indicated that they saw the benefit of experimenting with creativity as a way to develop new ideas, but also that they saw how their ideas connected to multiple pathways in the learning process. This understanding was another core area that the module wanted to foster, in helping students to understand that multi-disciplinary thinking and working, would equip them well for future roles in the workplace.

“...a creative mind-set can be just as valuable in a project as lines of code...” – Cohort 1B Student A

“Overall creating and developing the game application was very resourceful and pushed my creative thinking. I’ve learned to be able to have ideas only stay as ideas if you can’t develop them the intertwine with one another, as that solidifies the materiality of the idea.” – Cohort 2B Student E

“Imagination and creativity were very important in this stage as I found you needed to be able to think of multiple ideas with vast possibilities to achieve the best desired outcome.” – Cohort 2B Student C

Through the playful design thinking process, students are allowed to discover that the value of understanding and applying a creative process, is also connected to the understanding that not all ideas are right the first time around. It is in the mistakes and iteration process in which they are allowed to learn from unsuccessful design considerations. The idea of ‘failure’ was reframed and used as part of the learning process, in which students were encouraged that if an idea wasn’t suitable then it didn’t mean they failed, it just meant they needed to try another way of thinking about their design choices. This was used as a positive experience, with less emphasis on the negative connotations of ‘failure’.

“the whole process taught me that it takes many wrong ideas to create a right one” – Cohort 1A Student F
Since games are generally seen by the public as a product designed for pure entertainment reasons, one obstacle can be trying to convince others as to the value that games and play can offer for serious purposes.

Games are also growing as a culturally relevant form of aesthetic, creative and artistic expression, particularly on modern global and political issues. Surprisingly, this was an area that some students identified in their feedback and linked games and play to art from their experience of the module.

“I see games and these playful creations as a form of interactive art, which by its nature is a form of self-expression” – Cohort 1A Student C

“to sum up, this module has taught me that games can be used just like art to represent feelings, experiences and problems”– Cohort 1B Student F

The feedback suggests that a portion of the students gained necessary skills, to actively link the idea of the creative process to understanding complex and multi-disciplinary paths. These skills as identified previously, are needed for the changing landscape that students face when they leave the University for work. Fostering this creative process, in which students recognise the importance of imagination and process of connecting ideas up effectively, will be part of the continuing work on developing this module. The authors feel that this will be a key area for future consideration of University responsibility and support for our student body.

4.6 Team work

One area of the module that was reported across the four cohorts as one of the most challenging elements for the students, was that of working as part of a team. As described before, each student cohort was formed from across the different faculties and disciplines of the University, meaning that they mostly did not know each other in class. Differing course timetables and schedules provided most of the issues for the teams working together, as student team members found it difficult to arrange to meet outside of the modules lesson at a suitable time for all involved. Due to the practical nature of the course work on the playful design thinking module however, it was essential that they did find time outside of the lesson to work on their project together. Despite challenges around meeting and communication between the modules lessons, by week 10, students across the four cohorts displayed closer relationships and had produced a series of interesting and creative gameful and playful concepts for their project work. This was regardless of the short time that they spent together formally each week.

The theme of ‘team work’ was a popular area for student reflection. Mostly positive reports were received as the students reflected on the benefits and values of working in a team. They also linked ‘team working’ back to the multi-disciplinary nature of the tasks that were set in the module and how this has helped to understand that different people bring different skills to a project.

“overall, the experience honed my teamwork and marketing skills, appreciation of different mind-sets and skillsets.” – Cohort 1B Student D

“the whole process has improved my teamwork skills, marketing skills and environmental consciousness” – Cohort 2A Student C

“...I got to work with many people outside my course...” – Cohort 2B Student B

“Even in a short period of time, we were able to complete our task successfully and I am honoured to be assigned in a group that’s extremely dedicated and passionate in what every member does. I have certainly learned and gained knowledge from my team members during the 5 weeks process and would gladly be teamed up with them again if given a chance anywhere in the future”. – Cohort 2B Student A

Co-creativity and the process of learning how to compromise when working as part of a team was also highlighted as a skill that the module allowed the students to develop.

“What’s also required is the skill to work as a group and combine everyone’s thoughts into something that’s more than a compromise.” – Cohort 2B Student E
Part of the practical design of the module was that it was built to simulate that of a real working environment. By allowing students to take control of their learning through actively allowing them to plan and manage their own team, students could develop these skills of compromise and negotiation so that they could find a balance of when to put forward their ideas and when to allow others to do the same.

Part of ensuring that the inclusion of ‘team working’ as a learning strategy would be successful, was to build playful activities into the early weeks of the module that encouraged students to open up and feel ‘vulnerable’ in front of their cohort, but in a safe and structured way through play. Additionally each week, the module tutors would re-emphasise the underlying mantra of the course in that it was a safe space for ideas and that no ideas were wrong. Students were also encouraged not to be discouraging of their peers but to instead provide constructive criticism and ask questions on how they could build on each other’s ideas. Student feedback found that there was a positive effect on the students learning process in terms of confidence to share ideas, as several students reported feeling ‘psychologically safe’ in sharing their ideas to their teams.

“I felt psychological safety applied to me the most this lesson because working in a big group pushed me to take risks without feeling insecure when voicing my ideas.” - Cohort 2A Student D

“The psychological safety of the group was high as all group members passed no judgement, and supported the ideas of one another. If there was controversy within the group, it was approached politely with reasonable discussion, so a compromised solution could be made.” - Cohort 2A Student E

“The value of not being afraid/shy to share ideas…”- Cohort 1B Student G

This is an element of the playful design thinking module that the authors feel is vital to ensuring future success, in that students feel comfortable in partaking in, and contributing to lesson discussions and new ideas development. By tapping into the use of games and playful activities as part of the process to break down barriers between participants, students ultimately feel more open and comfortable in sharing their stories and ideas with each other.

One aspect of team working should be mentioned here as a caution however, in that disengaged or frequently absent students can cause a difficult working situation for the others members in their team, as reported below in one students reflections.

“I found these lessons more difficult as we were reduced to 3 people when most of the group were absent, including the project manager. However, I gained personal motivation from this, as it gave me an opportunity to take charge and push the team forward towards the goal. I’m now more comfortable with leading a large group towards a common goal as the previous 3 lessons made me see how taking that risk can benefit myself as well as the team.” - Cohort 2A Student D

However, in this scenario it is better to encourage the students that are present, that they control the direction of the project whilst others are not available. Tutors also made it clear in these cases, that students would not be penalised for lack of effort shown by team members which went some way to helping dispel fears connected to assessment.

4.7 Playful Design Thinking as an Approach

As part of the students’ reflective activities, the tutors asked students from across the four cohorts to summarise what they believed they had gained from participating on the playful design thinking module. The feedback that was given across all active students enrolled on the four cohorts, produced a series of responses that all contained positive reflections of their experience and skill gain as a direct result of the module. No negative responses were received in relation to this feedback. Below is a selection of some of the feedback received in response to this task.

“I think it has taught me a new way to discover innovative solutions. Implementing this throughout this module I think it is a very reliable model to generate ideas from a different point of view primarily from empathizing with the users beforehand to gain knowledge into what might not be the best solution but the one that helps the most to reduce empathy towards the issue.” - Cohort 2B Student C
“Overall, through learning to identify and apply the steps of design thinking process, we were able to design and produce a concept of a playful experience or product for our targeting audience. By identifying their needs, we were able to understand how to define the problem and solution. And through many iterations, coming up with new ideas, revising existing ones, improving others, we were able to come up with a solution that reflects our understanding of playful design thinking.” Cohort 2B Student E

“It has improved my design thinking because prior to this module I would jump straight into ideating instead of researching and defining a problem. I now know that it is better to research before you start because if you don’t you might create something that doesn’t solve the problem.” – Cohort 2A Student A

“Overall what I have gained from this module is that I taught me to be more open minded. It also helped me to listen other people ideas and consider their issues when applying our concept to the game. As well as the fact that this is group project and that all inputs and ideas should take to consideration.” - Cohort 2A Student C

“I now feel like I have gained an important skill when it comes to solving real world issues and understand the process of developing solutions in a playful way to aid others.” – Cohort 2B Student C

Students report a variety of skills gained including the ability to consider end-users, conducting research effectively, defining problems, becoming open-minded, ideas generation and the ability to consider others input and ideas. It is clear from the student feedback that has been gathered to date, that the playful design thinking module has come quite a way in positively addressing and impacting development of core skills with the students. As the module is an ongoing experiment, it is constantly being adapted and refined in order to use the students feedback to improve the core content and delivery. The latest cohort (2B) of the module completed the MEQ questionnaire in February 2019 which put the module at a 97.3 satisfaction score across the student body with a sample of the written feedback as detailed below (Table 1).

Table 1: Module MEQ Feedback Feb 2019

<table>
<thead>
<tr>
<th>Creative assessment and the environment of the classes.</th>
</tr>
</thead>
<tbody>
<tr>
<td>It’s fun, creative and you do something new.</td>
</tr>
<tr>
<td>Get to work in groups.</td>
</tr>
<tr>
<td>Creative</td>
</tr>
<tr>
<td>A good change from my modules.</td>
</tr>
<tr>
<td>Something to look forward to.</td>
</tr>
<tr>
<td>Clear deadlines are set.</td>
</tr>
<tr>
<td>We know exactly what we have to do.</td>
</tr>
<tr>
<td>The lectures are interesting.</td>
</tr>
<tr>
<td>Interactive</td>
</tr>
<tr>
<td>Refreshing</td>
</tr>
<tr>
<td>Passionate course leader.</td>
</tr>
<tr>
<td>Subject is interesting.</td>
</tr>
<tr>
<td>Lecture is helpful and straight to the point.</td>
</tr>
<tr>
<td>Lecture makes advantage interesting and willing to help out of classes.</td>
</tr>
</tbody>
</table>

5. Conclusions
The medium of play and games provides a particularly favorable environment to enact pedagogical innovation as, being interactive by definition, it allows participants to directly and explicitly engage with both the iterative (re)design of the formal, computation based rule system that defines the game mechanics and with the learning-from-failure that comes from engaging in interactive scenarios. Games present worlds with defined rules, clear objectives and often more than one possible solution to a problem, which enhances the context of design thinking. Based on the experimental module, we found that designing, developing and playing games through the GameChangers programme has the potential to further deepen content knowledge through the creation and application and testing of solutions, promote empathy in a learning process, allow for the discovery of purpose and meaning as intrinsic motivation, combine arts and technology, strengthen collaborative skills and build appreciation for the talents of others (nurturing cross-disciplinary hard and soft skills). The creativity and co-creativity developed through the process of design thinking with emphasis on
using play and games as inspirations has the potential to sustain the students’ mind-set and practices long term, which will impact how they engage with their studies, the community and the world of works.

Teaching is also a research tool in this case (Ainsley, 2014). The experimental module that has been used as our research instrument has been maintained as one of the formal elective modules beyond Cohort 1A. The following iterations (1B, 2A and 2B) informed by the findings from Cohort 1A has led to the module to provide more scaffolding in the earlier weeks to help students to “acclimatise” to the process faster including ensuring that the assessment was further clarified in the beginning. The outcomes synthesised from all four cohorts in this article demonstrate that this module has really enhanced the students’ experience in HE and will have value beyond their formal educational endeavours.

As part of the overall GameChangers initiative, the content of the module has also been adapted into an open educational resources (OER), accessible via the programme’s website (http://gamify.org.uk) and associated to the various workshop templates and toolkits. The initiative has also now been adapted in Malaysia through the Newton Funded CreativeCulture project (http://mycapsule.my), where teachers and students are developing their own playful educational resources and implementing them in rural schools in Borneo. This demonstrates the value and impact of playful design thinking, which should be included in education for promoting creative and empathetic problem solving.

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References


Assessment of Co-Creativity in the Process of Game Design

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Abstract: We consider game design as a sociocultural and knowledge modelling activity, engaging participants in the design of a scenario and a game universe based on a real or imaginary socio-historical context, where characters can introduce life narratives and interaction that display either known social realities or entirely new ones. In this research, participants of the co-creation activity are Malaysian students who were working in groups to design game-based learning resources for rural school children. After the co-creativity activity, the students were invited to answer the co-creativity scale, an adapted version of the Assessment Scale of Creative Collaboration (ASCC), combining both the co-creativity factors and learners’ experiences on their interests, and difficulties they faced during the co-creativity process. The preliminary results showed a high diversity on the participants’ attitudes towards collaboration, especially related to their preferences towards individual or collaborative work.

Keywords: game-based learning, game design, creativity, co-creativity process, collaboration

1. Creative education approaches for a critical and creative society

Nowadays, creativity is recognised as a critical competence in an increasingly volatile world, resulting in higher levels of uncertainty, complexity and ambiguity (VUCA, Bennis and Nanus, 1985) compared to prior centuries of the pre-industrial and industrial periods. Despite a growing corpus of theoretical and empirical studies on creativity in the last decades (Albert and Runco, 1999; Ryhammar and Brolin, 1999), creativity is a natural characteristic of humanity. Creativity is described as the ability to develop processes or achievements that are both new, relevant, and valuable while adjusting to the context in which they occur (Long, 2014; Runco, 2013, p. 201; Runco and Jaeger, 2012). Authors like Osborne (2003) criticise the fact that creativity has become a moral and socioeconomic imperative nowadays, while other studies highlight the socio-economic differences that are emerging between the “creative classes” and those who do routine jobs. Creative classes develop occupations where creativity is a determining factor; while routine workers are facing growing insecurity in urban environments (Florida, 2014). However, creativity is also defended among humanist approaches aiming to develop agency (Engeström and Sannino, 2013) or to engage citizens in co-creative solutions (Barma, Romero, & Deslandes, 2017). Moreover, creativity has been highlighted as one of the key skills for employment expected in 2020 (World Economic Forum, 2016). In education, creative pedagogies encompass different perspectives, including creative teaching practices and learners’ creative skills (Capron-Puozzo, 2014; Kiili et al., 2012).

1.1 Co-creativity as a person-team-situation interaction

Creativity is considered contextual and judgmental by a reference group (Romero and Barberà, 2014). The contextual nature of creativity is problematic in terms of its conceptual approach and the difficulties encountered when assessing it as a generic skill (Burnard, 2006; Puozzo, 2016). Moreover, the contextual and situation-specific nature of creativity is defended by Woodman and colleagues (1993) within an interactionist model of creative behaviour, “that incorporates elements of personality, cognitive, and social psychology explanations of creativity. In the model, creative behaviour is viewed as a complex person-situation interaction” (Woodman and Schoenfeldt, 1990, p. 279), which engages a complex interaction between the person and the situation. In a co-creative activity, we assume that interaction is not only developed within the person and the situation, but as a person-team-situation interaction, which requires a multilevel approach to
analyse creativity. To identify the multilevel nature of co-creativity within the game design process, we consider co-creativity as an element within the broader creative pedagogy framework (Figure 1).

**Figure 1: Creative pedagogy framework**

The multiple levels of the creative pedagogy framework shown in Figure 1 should be considered in its entirety. Within this study, we focus on the teamwork level and the co-creative self-assessment developed by the participants. Within the creative approach of the participants, we consider not only the situation, and the way teams overcome their difficulties during the co-design process but also on their attitudes towards creative activity. Within the set of creative attitudes related to creativity, we will focus on tolerance to ambiguity (DeRoma et al., 2003) as “the tendency to perceive ambiguous situations as desirable” (Budner, 1962, p. 28). In creative activities in which learners are not supplied with all the required information leading to a solution, described by Simon (1973) as ill-defined problems. Between well-structured and ill-defined activities, there is a broad spectrum of activities providing different degrees of creative freedom in the process and the outcomes of the activity. We can consider the degrees of creative freedom to be the number of possibilities learners have to develop the activity process and the outcome process in a different, but still valuable, way. The degrees of creative freedom can be regulated by the teacher in introducing constraints reducing or expanding the degrees of creative freedom.

The appreciation of the degrees of creative freedom experienced by the learners could depend on their tolerance to ambiguity, but also contextual aspects as the cognitive load level or the collaborative settings of the activity. Activities with a high degree of creative freedom could be inconvenient for students preferring well-defined activities, providing them with a clear structure and guidance. In these cases, some learners show their rejection of highly creative activities and describe to prefer well-structured activities (Cliburn et al., 2010).

**2. Designing games for learning**

Playing games could support certain types of learning, but participants can also learn from designing games (Arnab et al., 2017; Cucinelli et al., 2016). When creating games, the participants shift from a consumer approach of digital technologies towards a co-creative approach transitioning from consuming technology to the co-creating through technology has been possible, thanks to two essential levers: the technological evolution and the spread of the participatory approach in education. Firstly, the evolution of technologies resulted in the popularization of game engine platforms, and the emergence of visual programming platforms.
such as Scratch, but also led to the creation of basic arcade-style games, indie-style games or even pattern-based games, in which the participant can customize an existing game pattern (Richard & Kafai, 2015; Woods, 2015). Secondly, in research and media studies, there has been a tendency to consider the participant as a creative agent within a shared collective creation process, rather than as an end-user who will be engaged as an interactive consumer of a professionally-developed product.

3. Malaysian game design workshop

As part of the CreativeCulture project (http://mycapsule.my), a four-day workshop was held at the Learning Sciences Studio, situated at the Faculty of Cognitive Sciences and Human Development UNIMAS, Malaysia.

Eighteen Masters students (n=9 were trained teachers) in Learning Sciences, were enrolled in a course on Computer-Supported Collaborative Learning (CSCL) and were engaged in a Design Thinking workshop within their CSCL course. The workshop aimed to provide an opportunity to co-create game-based learning resources in the fields of English as Foreign Language (EFL) and Sciences Technology Engineering and Mathematics (STEM). None of the Masters' students has used a gamification approach in learning. Playful-and-gameful approaches to education inspire the Design Thinking workshop. The main contents of the workshop have been developed by the GameChangers initiative (Arnab et al. 2017) and were adapted to the Learning Sciences field.

In the adaptation process, the focus was placed on the process of learning, and strategies to determine how gamification elements can be integrated into learning.

The Design Thinking workshop initiated four months’ worth of work, as the Masters' students used the knowledge and skills they learned in the workshop to conduct Gamification of Learning sessions at two rural schools. While developing the EFL and STEM game-based learning resources, the students also needed to incorporate the use of technology into the gameplay, to fulfil the requirements of the CSCL course.

Designing game-based learning resources for the rural schools posed a challenge for the master’s students; a majority of them were only familiar with urban and semi-urban schools. From the start, they felt less confident with subcultures of ethnic groups in both locations. At these two schools, the school subculture was dominantly identified by the majority ethnic Malay; in the case of the master’s students, they mainly have had experience in learning and teaching in majority ethnic Chinese, Iban and Bidayuh, where school subcultures were valued differently.

Figure 2: Malaysian students during the co-creation process

4. Methodology

In the workshop, the participants went through a three-stage process: the co-creation phase, the piloting phase and the reflection phase at the end. We describe below each the stages and their different steps.
4.1 Stage 1: Co-creation of game-based learning resources via the GameChanger’s design thinking process

The design process, based on the GameChanger’s approach, aims to make game-based design thinking more accessible to anyone with a different level in game playing. Inspired by the engaging nature of play and gameplay as a tool for learning (Fabricatore, 2007), the workshop required the participants to emphasise on designing playful experiences suited for the target audience (primary-level STEM education). Participants were divided into six groups. Each team was informed on the type of game-based resources (digital or analogue) that could be co-created to facilitate engaging learning experiences. At the end of the workshop, the teams developed six game-based learning resources. Five steps were utilised to create game-based learning resources. These five steps were coherent with the design thinking approach (Owen, 2007) of the participatory design (Cucinelli et al., 2016) in which the participants go through different phases for iteratively developing the game. By working on iterative cycles of improvement, the participants can engage in different ideas and support their co-creativity.

Stage 1 - Step 1: Understand the needs, context and audience. What are the key challenges you wish to address? What are the objectives/aims/goals? Who are your stakeholders? And in what context would your solution/intervention be implemented?

Stage 1 - Step 2: Get inspired by existing play and gameplay. What play and game activities do you like most? Can you list them out? What is the core mechanics of those activities? Are there any particular game and play strategies that you can think of? Map the different mechanics and use them as inspirations for the next step.

Stage 1 - Step 3: Map the needs and goals of the mechanics and strategy. How would you engage the stakeholders? Will specific strategies promote the aims and objectives you set out? What play and game activities would develop specific actions, attitudes and/or behaviour?

Stage 1 - Step 4: Design your game. Design and develop your strategy/solution/product/experiences that will address the challenges, achieve the goals and engage the stakeholders in the context that you set out in the beginning. Test your game.

Stage 1 - Step 5: Pitch your game. Share your game plan and get feedback from your peers.

4.2 Stage 2: Piloting of the resources developed in schools

For the CreativeCulture project, two rural schools had been pre-selected for the training. The pilot activities were also part of the iterative testing process that the Masters’ students managed. The selected schools shared similar demographic characteristics - they were coastal fishing villages, predominantly ethnic Malay, and of a low socioeconomic income group. Four gamification sessions were held at the two schools. In the first session, Gamification in Learning for the teaching of STEM subjects was introduced to the school teachers. The output of the first session was a selection of learning contents which were identified by the school teachers. The contents were further developed into learning games by the Masters’ students. The subsequent sessions were conducted with the primary school pupils, in which they engaged in games developed by the Master's students and their teachers through a co-creative process. Within the CreativeCulture project, teachers and pupils were engaged in the co-creative design, development and playing moments of the project.

4.3 Stage 3: Reflection from the teachers via the co-creativity questionnaires (Data Collection)

During this stage, the participants filled out a questionnaire based on the co-creativity scale, an adapted version of the Assessment Scale of Creative Collaboration (Romero and Barberà, 2015; Wishart and Eagle, 2014). This new version contains a five-level scale, combining both the co-creativity factors and the participants’ reflections on their preferences, and the difficulties faced during the co-creativity process. The participants’ observations were reported through open questions focusing on the positive and negative aspects of the game co-creation process, and the main difficulties faced during the project and the strategies developed to overcome them.
5. Results

We analysed the answers, focusing on the participants’ perceived levels towards tolerance of ambiguity, which we linked to their preference to have either very guided instructions or ill-defined tasks. Based on these preferences, we differentiated between participants with a low level of tolerance to ambiguity (n=10 and including answers from 1 to 3) and participants with a higher level of tolerance to ambiguity (n=4 and including answers from 4 to 5). Four participants did not answer the co-creativity scale.

5.1 Co-creativity self-assessment according to the tolerance of ambiguity

Participants with a low level of tolerance to ambiguity tend to assess their game design more favourably in terms of efficiency, originality and value. Those with high levels of tolerance towards ambiguity are found to be more critical when judging their co-creative outcome after the co-creation of the game.

![Figure 3: Co-creativity self-assessment according to the tolerance of ambiguity](image)

5.2 Task preferences according to the tolerance of ambiguity

Participants with low levels of tolerance to ambiguity paid more attention to detail, took pride in work well done and preferred more straightforward tasks requiring little abstraction.

![Figure 4: Creative orientation of the CreativeCulture learners](image)

5.3 Attitudes towards teamwork and errors according to the tolerance of ambiguity
Participants with low tolerance to ambiguity, are more prone to help others, tend to accept their errors and those of others, but also prefer individual work above teamwork. When facing difficulties, they are more willing to intervene and to act.

Figure 5: Attitudes towards teamwork and errors according to the tolerance of ambiguity

5.4 “What were the main positive aspects of the project?”

The main positive aspects of the project, as highlighted by participants were related to the cooperation within their team. For example, one of the participants mentioned that the main positive aspects of the CreativeCulture project were that “they were able to work together towards a common goal they invested in”, while another student appreciated “to collaborate among themselves despite their different backgrounds and ideas”. The statement reflects the diversity of ideas experienced during the initial stages of the co-creative process. Another student highlighted on the convergence process after the initial divergent stage: “the group itself became closer as they carried [on with] the project. [Participants] were able to understand each other better and therefore, conducted the project wonderfully”. Participants also thought “it was possible to obtain new and creative ideas from their team-mates” and agreed to value the diversity of ideas shared within the team. During the co-creation process, they were aware “they could collaborate and help the pupils to learn by gamifying”.

Moreover, they also understood that teamwork produces better outcomes than individual work. For them, it was possible “to learn from others perspective”. Participants also highlighted that “the project inspired the teachers’ ideas to (re?)design their teaching approach”.

Co-creative attitudes were found to be necessary during the co-creation, and the Masters’ students also highlighted the trust required from team members and the “creative and fun elements experienced when developing games”. They remarked that a “fun, creative and trustful atmosphere was necessary during the co-creation process”.

5.5 What were the main negative aspects of the project?

Negative comments were made on the poor organisation (of what?) and a lack of collaboration and sharing (of what?) that led to tensions and an imbalance (of what) in the student teams. Participants found that “the time to prepare for the project was insufficient”. Furthermore “some of the members from other team became a little too competitive, even though both teams were supposed to work together”. Another problem raised was that “both teams involved in this project faced conflicts due to “different opinions” and “some people refused to discuss other ideas”. In this case, a participant highlighted that “communication breakdowns led to frustration and disappointment”. It led to “miscommunication, unfair distribution of work between team members and the other team to organize a collaborative activity”.

5.6 What were the main difficulties encountered during the creative project?

The main difficulties encountered are based on “limited resources and expertise to build products and services” in order “where all members agreed on”. A difficulty mentioned was how “they could produce a
relevant game”? It is hard to “create games suitable for learning, especially for primary students”, and “how ideas could be transformed into games”. Another challenge is “to come to an agreement for the solution used within the project, and to figure out the motives of others”. Also, “the learners were «constantly chasing time, and communications problems make it harder”. While having fun and having problems could be perceived as incompatible, we understand the possibility to have fun while fighting through the “effortful pleasure” or “pleasurable effort” concept of Rosenbaum (1990). Furthermore, during the actual roll-out on the site at the rural schools, “unexpected weather conditions blocked the entrance of the project site”.

5.7 How did you overcome them, or do you plan to overcome them?

To overcome difficulties, participants described how they “voted” or “discussed within the team”. In other cases, they asked the school teacher for help (in their words, they “interviewed the teacher”) or “confronted the [team] member even though he is older”. The participants declared they had the intention “to have more open discussions and to ironing out issues”. Also, they added all members did their best to read through the journal articles related to gamification and to “figure out the best way to solve the problems”. The participants explained they did their best to overcome the game challenges by simulating the activity beforehand. They planned for contingency for instances where specific problems would occur. They also presented the ideas about the games they developed, so they were able to gauge what was learned while playing the games.

Another participant confessed how he initially faced difficulty with solving the problems encountered but was soon able to find out “every problem has its solution”. Participants also took the initiative to “visit an institution to get inspired”, which helped them to commence with gamification for their project.

6. Discussion

Co-creativity is key to encouraging collective knowledge, experiences, interests and expertise, and to be exploited towards larger projects that could potentially lead to creative solutions impacting the significant challenges currently faced in society (global warming, climate change and so forth.). Designing and creating games as an activity on the edge of the diverse fields of Art, Design, Science, Computation and Engineering, can be a fertile ground to cultivate such competencies through multi-disciplinary collaboration, and by providing a playful (engaging), creative and innovative space for people to meet and learn how to cooperate fruitfully. The CreativeCulture project provides a platform for those who are not used to engage in game design to co-create gameful solutions for teaching and learning of STEM topics, focusing on the rural schools in Malaysia as the target audience for these game-based learning resources.

The co-creation experience with the Masters’ students confirmed our assumption that pedagogical and content knowledge are challenged when designing games for schools with subcultures that are unfamiliar to the participants. It also shows the importance to situate the learning cultures of schools, and to make the learning experience aligned to the local teaching practices. Co-creativity also enabled the students to interact in this project, which helped them to create their game-based learning modules. However, further work is required to understand the existing assumptions, motivation and determination to learn and teach in various school settings. Eventually, co-creativity requires a positive team climate, which is mainly related to the error and ambiguity tolerance observed through this activity. The team climate and attitudes are one of the most important lessons learnt through the co-creation experience with the Malaysian Masters’ students, and with the other teams engaged in co-creativity activities within the activities, we developed in the last years (Cucinelli et al., 2016; Romero et al., 2016). Further work is required to allow more time for the students and teachers to co-create game-based resources to meet the needs of different schools, which will include repurposing existing traditional games that are more relatable to the community.

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References


The Gameplay Loop Methodology as a Tool for Educational Game Design

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Abstract: The field of game design for educational content lacks a focus on methodologies that merge gameplay and learning. Existing methodologies typically fall short in three ways: they neglect the unfolding of gameplay through players’ actions over a short period of time as a significant unit of analysis; they lack a common consideration of game and learning mechanics; and they falsely separate the acts of playing and learning. This paper recommends the gameplay loop methodology as a valuable tool for educational game design, as it addresses these major shortcomings. Furthermore, this paper outlines how this methodology can be supported by knowledge from subject-specific didactics—considering both the curriculum and its mediation (contributed by experts from educational practice) as well as methods of player-centered design—in order to ensure the appropriateness of learning objectives and techniques of mediation in the context of a particular field of knowledge, the game’s appeal to its target group, and the effectiveness of the learning mechanics. A case study of the design and production phases of Antura and the Letters, a literacy game for Arabic refugee children, illustrates the uses of the gameplay loop methodology situated in the described broader approach to educational game design. Finally, this paper explains the results of an impact study revealing that the approach indeed provides the opportunity to merge playing and learning.

Keywords: serious games, educational games, instructional design, game design, gameplay loop, player-centered design.

1. Educational game design: A merging of game and instructional design

The design of educational games is a complex endeavor because educational games are expected to fulfil two requirements, which at first seem contradictory: educational games should be as appealing as commercial, off-the-shelf games designed solely for entertainment, and they should provide their players with a learning experience related to educational domains beyond the game itself. Consequently, the design of educational games must be informed by two different disciplines—game design and instructional design—that bring different histories and approaches to the table (Becker, 2016). In our opinion, the successful design of educational games presupposes a significant merging of both disciplines, in other words, a formal approach combining game and instructional design (see Buchanan, Wolanczyk and Zinghini, 2011).

In response to the aforementioned requirement as well as to massive growth in serious game production in general and educational game production in particular, ideas from game design and instructional design were synthesized to form a new field, more specifically, (inter)discipline that is usually called “Serious Game Design” or “Educational Game Design”. Lameras et al. (2017, p. 972) describe serious game design as “a relatively new discipline that couples learning design with game features” and state that “[a] key characteristic of this approach is grounded in educational need and theory, rather than a focus purely on entertainment”.

In this field, it is undisputable that serious game design poses different challenges from entertainment game design and requires a unique methodology that addresses both instructional strategies and learning theories. Gunter, Kenny and Vick (2006), for instance, assume that “[t]he goal of serious game design is similar in nature to that of entertainment games, but is more complex, in that not only must one maintain intellectual control of the design elements that lead to a fun and engaging game, but one must also plan instructional elements that lead to a fun, engaging, and educational game experience”. The authors argue consequently that “instructional strategies and learning theories must be included” (ibid.) in the formal methods of serious game design. Accordingly, in recent years, many authors have suggested formal design patterns, frameworks, and

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Footnote 1: We define serious games as all digital games acting as more than entertainment, including not only educational games, but also games for health, advergames, etc., whereas we define “educational games” as all digital games that are explicitly designed for educational purposes in formal, non-formal, and informal learning contexts. In this paper, we are concerned with the design of educational games in particular instead of serious games in general. However, we are aware that the majority of available literature relevant for our research and development project employs the broader term “serious games” in reference to “educational games”. Therefore, we will use the term “serious games” whenever we refer to this literature, as well as to the broader category.
methodologies to offer guidelines for the design of serious games. As most of them were developed in academia (which is closely connected to the relatively small serious game industry), many are more abstract and less practical than traditional game design methodologies, which were developed inside the gaming industry and are thus more strongly influenced by its market-driven logic of immediate application.

Despite major achievements inside the academic field of serious game design, for example Arnab and Clarke (2016, p. 279), assessing the theory and practice of serious game design, still assume the following: “The development of these games does not normally follow a specific set of guidelines or process, which makes them more bespoke and less replicable. Moreover, existing frameworks or guidelines are often high-level and/or theoretical design models that provide general design considerations rather than a prescribed development process”.

It can be concluded that there is still a high demand for new methodologies for the design of serious games, and particularly educational games. In the present paper we will thus introduce the gameplay loop methodology as a valuable tool for educational game design.

Next, we will offer a closer look at existing approaches to the design of serious games in order to highlight their shortcomings with regard to educational games. At the end of this section, we will outline our research question and design. We will then explain our broader approach to educational game design, in which the gameplay loop methodology is situated. Afterwards, we will more closely emphasize the gameplay loop methodology as a necessary technique for designing educational games. The application of the gameplay loop methodology will be illustrated through a case study of the design and production of Antura and the Letters, a literacy game for Arabic-speaking refugee children. Finally, we will summarize results of an impact study showing that our approach is able to initiate a unification of playing and learning. We will close the paper with a discussion as well as a conclusion.

2. An analysis of existing serious game design methodologies

In recent years, the number of papers proposing methodologies for the design, analysis, and evaluation of serious games, including educational games, has increased tremendously (see Ávila-Pesántez, Rivera and Alban, 2017 for an overview). After reviewing the current body of serious game design literature and focusing on the methodologies’ value for the design of educational games, we have concluded that most approaches favor a bird’s eye view of games and their overall design, more specifically their various features, over a closer, more detailed perspective of gameplay and learning possibilities. Learning objectives, for instance, are rarely considered throughout each stage of design, let alone associated with game mechanics and/or gameplay.

Consequently, we argue that many approaches lack a significant merging of game design and instructional design.

Important contributions to the field of serious game design include de Freitas and Oliver’s (2006) four-dimensional framework (4DF model) and Mitgutsch and Alvarado’s (2012) Serious Game Design Assessment Framework (SGDA Framework). De Freitas and Oliver suggest that developers consider context, learners, pedagogy, and representation for the design and evaluation of serious games; Mitgutsch and Alvarado (2012) relate the purpose of the game to game mechanics; framing; content and information; fiction and narrative; aesthetics and graphics; and coherence and cohesiveness of the game system. Although both frameworks are based on a holistic design approach, offer useful guidance for the design of well-rounded educational games that motivate players, and include learning possibilities, they, like many other approaches to serious game design, do not emphasize the actual processes of learning enough—which should be of particular importance in the development of educational games.

Other approaches such as Gunter, Kenny and Vick (2006), Winn (2008), and Becker (2011) consider learning more directly. According to Buchanan, Wolanczyk and Zinghini (2011: ch. 3.2), the integration of learning objectives into the approaches of the field “ranges from a mere suggestion to a core principle of the framework’s design approach”. Unfortunately, many of these approaches lack an adequate appreciation of the procedural nature of learning as well as a proper consideration of the relationship between learning mechanics and game mechanics. Furthermore, they neglect—as others have pointed out before—“the actual design
Pattern-based approaches aim at an integration of educational and game design principles (see Kiili 2010; Kelle, Klemke and Specht 2011). According to Kiili (2010, p. 299), learning game design patterns “are descriptions of commonly reoccurring parts of the design of a learning-game that concern and optimize gameplay from an educational perspective” (ibid). Carvalho et al. (2015, p. 169), however, debate that the libraries of patterns identified by these kinds of approaches “neither offer the classification of individual components [of the game] nor an account of the relationship between them”.

Assessing the field in general, many authors indicate the missing “analysis of the relationships between game mechanics and learning constructs” (Arnab et al., 2015, p. 394), which is seen as “a key factor in game design for learning” (Arnab et al., 2015, p. 394). Lameras et al. (2017, p. 973), for instance, highlight that “[t]here are no pedagogically driven strategies that take into account how learning attributes are interlinked to game elements for balancing learning with play”. According to these authors, “[t]his is due to a limited evidence base of comparative evaluations assessing differing game designs against a single pedagogical model or vice versa” (ibid).

The Learning Mechanics-Game Mechanics (LM-GM) model by Lim et al. closes this gap as it maps aspects of learning and instruction to game mechanics: “To map pedagogical constructs to entertaining gameplay, Lim et al. (2013) proposed the LM-GM and was evaluated by Arnab et al. (2015) as an SG analysis guideline with positive outcomes. As a general overview, the educational elements are viewed as an abstract while game elements are deemed as a concrete interface of SGs. This means that pedagogy and its methods are abstract (theoretical and conceptual), while game mechanics are concrete, i.e., by rules or algorithms” (Arnab and Clarke, 2016, p. 286).

The model shifts the focus of serious game design to game mechanics, which too often have been neglected in the literature on serious game design methodologies. This shift is overdue and of particular importance as the majority of the academic serious games community’s theories assume that game mechanics are a key factor for the successful initiation of learning. Arnab et al. (2015, p. 396) argue as follows: “In SGs, game play should support intrinsic experiential learning. It is therefore reasonable to postulate that knowledge acquisition and skill training should be obtained through game mechanics (e.g., quests, cascading information, leader boards, goals, levels, badges, role-play, tokens, etc.)—and not, for instance, from related user manuals. Thus, we tried to investigate how to establish relationships between the mechanics present in educational philosophies (pedagogical theories and strategies) and those of games”. However, as Carvalho et al. (2015, p. 169) point out, LM-GM is limited as it “does not expose the connection between concrete mechanics and the high-level educational objectives that the game is supposed to attain”.

Despite significant progress achieved through the models mentioned above, it should be emphasized that they “do not cater for presenting formulaic strategies or methodologies” (Arnab and Clarke, 2016, p. 282). Therefore, applied methodologies that offer concrete guidance for educational game design are still urgently needed.

In addition to the criticisms raised by Arnab et al. (2015), it should be mentioned that overall too many approaches model learning solely as a result of gameplay and thus reduce it to learning outcomes. These approaches do neither take into account that playing and learning are highly interconnected categories of analysis, nor that learning in general must be seen as a process (Gee, 2003). Furthermore, players’ actions are not assessed individually, such that each action that a player executes is examined for its contribution to the whole learning experience. Instead, players’ actions are observed rather superficially, over the course of a single session, or multiple sessions. Thus, most approaches lack a micro-perspective of players’, or more specifically learners’ actions in sequence – including their learning potentials (while taking into account the challenges of the game).

Considering major shortcomings of the methodologies mentioned above—including the neglect of the unfolding of gameplay through players’ actions over a short period of time as a unit of analysis; the lack of a common consideration of game mechanics and learning mechanics; and the false separation of playing and
learning—this paper suggests the gameplay loop methodology (Guardiola, 2016) as a valuable tool for the design of game-based learning.

This methodology is situated in a broader approach to educational game design which does not only imply the application of player-centered design methods, but also the consideration of domain-specific didactics, the latter being neglected in many existing educational game design methodologies as well.

The study reported in this paper applies an exploratory qualitative research design based on a single case that exemplifies the application of the methodology. In the presented case study, the paper demonstrates how the gameplay loop methodology has been successfully used to design an educational game which consists of a series of meaningfully connected mini-games and relies on cognitive theories of learning. In addition to the case study reflecting on the design process, the paper provides evidence from an impact study by Koval-Saifi and Plass (2018), which reveals that the approach can actually lead to significant learning outcomes.

By exemplifying the application of the gameplay loop methodology and comparing it to other approaches, the paper answers the following research question which is highly relevant for applied educational game design research: How does the gameplay loop methodology facilitate the design of educational games that initiate a unification of playing and learning?

3. The gameplay loop methodology as the central part of a broader approach to educational game design

Before providing a detailed exemplification of the gameplay loop methodology as a tool of educational game design (in section 4), we will situate the methodology in our broader approach to educational game design, as applied in the design and development of Antura and the Letters.

3.1 The gameplay loop methodology as a tool for entertainment and educational game design

The gameplay loop methodology comes from the entertainment game industry, used during the early stages of a production, in particular during the concept phase and pre-production. The goal is to formalize the player experience called gameplay. Gameplay refers to the sum of actions and activities performed by the player interacting with the game, trying to solve the uncertain situation he or she is engaged in. Formal representations of gameplay, such as the gameplay loop, emerged from this often collaborative practical design task and the need to document it. Guardiola (2016) describes and models this method in order to facilitate its use for design, teaching, and analysis.

The method consists of listing a certain number of player actions, represented by verbs and minimal context. These sparse depictions of action are then connected in the form of a flow chart. During the design process, the objective is to formalize the core gameplay of the game, or multiple gameplays, using these flow charts, and use them to determine what sorts of challenges these actions might present to players and determine what kinds of abilities are required to complete these tasks.

One of the characteristics of this method is the possibility to represent all the types of actions or activities that the player executes, for example, actions that have an immediate, measurable effect on the virtual world, such as pressing a button, as well as actions outside of the game, for instance planning something. Applied to the game-based learning field, the gameplay loop helps to visualize the different types of abilities that learners use to solve a situation and determine whether the actions that constitute a specific gameplay contribute to pedagogical and/or entertainment content.

3.2 Antura and the Letters’ experimental context

Antura and the Letters (Cologne Game Lab/TH Köln, Video Games Without Borders and Wixel Studios, 2017) is an educational and humanitarian research project led since 2016 by the Cologne Game Lab of TH Köln, in collaboration with the non-profit organization Video Games Without Borders and the Lebanese game company Wixel Studios. Antura is an educational mobile game addressing mainly five- to ten-year-old Syrian child refugees in the Middle East. Due to the Syrian conflict, nearly three million children have dropped out of school or are in precarious educational situations. The pedagogical goal of the game is to help players acquire the most basic skills of literacy: Arabic letters, spelling, and some vocabulary. The project was funded through
prize money from the international contest EduApp4Syria, organized by the Norwegian Ministry of Foreign Affairs. Antura is an open source project.

Most of the development team was composed of experienced game developers from the industry who have more experience developing entertainment content than educational content. The pedagogical content was developed in collaboration with Arabic literacy experts and Syrian elementary school teachers. The concept phase started in February 2016. Pre-production took place between May and August 2016, and main production continued until March 2017, when the open beta was released on major mobile app stores. The beta version was used for a large impact evaluation in refugee camps in Jordan (see section 5). The game is free and currently available worldwide on mobile and on PC. By January 2019 Antura had reached over 120,000 users across all platforms.

3.3 Our general approach to educational game design: The gameplay loop methodology, subject-specific didactics, player-centered game design

From the start, Antura and the Letters aimed to be a game in the fullest sense. Thus, the approach was not to try to create cosmetic, overly explicit pedagogical activities, but to take all the benefits of a real play experience. Our objective was to trigger principles such as flow, engagement, and motivation, as they would emerge from a purely entertainment-oriented game. Our work on the narrative context, the game mechanics, the signs and feedbacks, the reward system and all other aspects of the content were directly influenced by empirical practices from the entertainment industry.

In the game, the player is tasked with helping the keeper to watch over wild little creatures called the Living Letters. The player explores several environments on a step by step walkthrough. Antura is the clumsy keeper’s dog, helping through each mission. At each step in the game the player must play several mini-games involving some of the Living Letters and Antura the dog. Each of these mini-games is designed to present the player with a challenge connected to a specific pedagogical goal.

3.3.1 Overview of our design approach

Overall, our design approach consists of the following structural elements: (a) consideration of knowledge from subject-specific didactics in terms of the curriculum (learning objectives) as well as its mediation (appropriate teaching methods), i.e., in our case Arabic language pedagogy provided by Arabic literacy experts and Syrian elementary school teachers, (b) the gameplay loop methodology as such, (c) methods from player-centered design.

The gameplay loop methodology (b) stands in the center of our approach. By applying this methodology, learning mechanics are designed, i.e., learning opportunities are implemented into the game. Thereby, the methodology aims to merge playing and learning. The other structural elements support this very process. While (a) ensures the pertinence of learning objectives and methods of mediation in the context of a particular field of knowledge, (c) influences the game’s appeal to the target group and the effectiveness of the learning mechanics.

All of the above-mentioned structural elements are embedded in an overall iterative design process (figure 1). During our concept and pre-production phases, we defined a set of learning objectives and teaching methods based on Arabic language pedagogy and considered the target group (element a), and thereafter integrated these micro-pedagogical objectives into the game by using the gameplay loop methodology (element b). Afterwards, we applied methods from player-centered design to evaluate the goals of our design process to improve our prototype’s qualities as both a game and learning tool (element c). Next, we returned to element a and b, and so on. The relationship between the structural elements is circular. We applied this iterative design process most intensively during the concept and pre-production phases, but also used it occasionally in the production phase.
3.3.2 Subject-specific didactics

Subjects such as math, geography, and languages follow their own didactics concerning their curricula (what should be learned) and their mediation, i.e. teaching methods (how can learning be initiated). During the concept and pre-production phases of Antura and the Letters, we worked with Arabic literacy experts and Syrian elementary school teachers to determine learning objectives and subject-appropriate teaching methods from non-game contexts that may be translated into a game context.

The experts and teachers’ first task was to create a finite list of micro-pedagogical objectives that were linked to the process of learning the alphabet and the various forms of its letters, reading and spelling principles, acquisition of new vocabulary and eventually reading fluency. We identified a group of 19 micro objectives. In figure 2, which is an extract from an early design document, you can see the micro objectives on the top of the table, in each column. Each of them covers a precise topic. For instance, the goal could be to deal with “one letter” and to focus on “the name of the letter”, “the pronunciation” or the “shape” of it. We added a twentieth objective for “unique objectives”.

During the design process in the concept and pre-production phases, we managed to create many mini-games, with gameplays that permit all of the micro pedagogical goals. For the team, this table was a way to check if we had covered them all. Each row is dedicated to a mini-game and shows the intended pedagogic effect. When the cell in the row contains a “X” or “XX”, it means that the core gameplay of the mini-game addresses this pedagogical objective. Sometimes we also expect pedagogical impacts simply by the way the game is introduced or by the way it gives feedback to the player. For instance, one mini-game is introduced by the voice of a character asking the player to find the letter Alif while showing the shape briefly. This introduction in of itself has also a pedagogical value. We reference these side effects as “intro”, “result”, “feedback” depending in which stage of the mini-game this reinforcement happens.

We initially planned to have several mini-games working toward the same pedagogical goal so that we may provide variety in the player experience. Our first design listed 40 mini-games, 22 unique gameplays and 18 additional variations. For instance, the gameplay of the mini-game Balloon – Letter in a word was planned to be reused for variations Balloon – Spelling or Balloon – Word Image (vocabulary oriented). We designed each of the mini-games on paper at this stage, using the gameplay loop approach, as it is detailed in section 4. For production reasons, we had to reduce the total mini-games to 30, composed of 17 different gameplays and 13 variations. After the release of the beta version and multiple playtests, we again reduced the number of games to a total of 24 (13 gameplays plus 11 variations), keeping and improving the most efficient ones.
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3.3.3 Player-centered game design

Player-centered game design is a widely used practice in today’s game development. Its iterative design process is applied all throughout the medium, from huge AAA productions, to small indie projects, to game design education. Approaches to player-centered game design are related to and inspired by the tradition and practices of user-centered design (see Norman 1990). However, Hodent (2017) argues that games must not only be “usable”, but also “engage-able”. Thus, her approach introduces the concept of “engage-ability” to player-centered game design, while maintaining the significance of the well-established concept of “usability”.

The concept of “engage-ability” is supported by the core pillar of “motivation” (considering players’ needs for competence, autonomy, and relatedness), which is supported by the pillars of “game flow”—a state of enjoyment—and “emotion”—the game feel (ibid.: p. 137). Player-centered game design, then, should ensure that games are easy to learn, fun to play, emotionally appealing, and able to keep players motivated, which includes allowing them to experience a state of “flow” (Csikszentmihalyi, 1990) over and over again (see Fullerton, 2014; Salen and Zimmerman, 2003). For this purpose, player centered design applies methods of social research such as focus groups, observations, or analytics (tracking in-game player behavior). The results are subsequently used to improve the game. Afterwards, another collection of data takes place, and so on. This iterative design process is repeated until the best possible outcome has been reached.

Arguably, it is more important to consider the player’s perspective in the field of educational game design than in other game design contexts. Educational games are generally designed for a broader target group than many entertainment games (e.g. educational games that are designed for a school context) and thus they must not take entertainment games’ standard of game literacy for granted. At the same time, other games are designed for very specific audiences (e.g. games for groups of people with certain restrictions, such as a disability), whose general game literacy remains unexplored. Thus, it seems to be more difficult for educational game designers to meet their players’ preferences and needs. Hence, early playtesting with members of the target audience is a key step in making educational games accessible, usable, and appealing. This becomes more complicated when we consider the fact that it is not sufficient for educational games to be simply accessible, usable, and appealing; they also must fulfill their educational objectives. In other words, they must enable players to gain knowledge and/or skills. Therefore, in iterative player-centered educational game development, the evaluation of the educational impact is of paramount importance.

Throughout the design and development of Antura and the Letters we used a variety of methods, such as focus groups, persona, and analytics, to evaluate various prototypes of the game. Major lessons we have learned that have allowed us to improve the game do not only concern the game’s appeal to the target group, but also its general didactical approach as well as the relationship of playing and learning in several gameplay loops.

For instance, we switched to a more phoneme-based approach in the game, instead of a letter-based approach. Children now learn a few letters and start to read simple words relatively quickly, instead of learning the entire alphabet first. This enables children to see the utility of what they are learning sooner. It also reduces the game’s duration, which was too long in the first version, causing children to lose motivation to complete the game. When it comes to gameplay loops, our player-centered approach led to an easing of difficulty and a closer relationship between playing and learning in several cases (see examples below and in Guardiola, Czauderna and Samur, 2019).

In the following section, we will finally discuss the application of the gameplay loop methodology as a valuable tool for educational game design.

4. The application of the gameplay loop methodology in the design of Antura and the Letters

The gameplay loop methodology was applied during the design of the mini-games. For each mini-game, we formalized a gameplay loop, incorporating every type of action that the player would have to perform to achieve their goal. Initially, we tried to separate the formal aspect of the action blocks in the flow chart to have a better reading of the types of challenges facing the player: Orange for actions that implied pedagogical challenges; blue for actions that did not imply pedagogical challenges, including, but not limited to, purely ludic ones.
Figure 3 is extracted from the initial game design document created during the pre-production phase. It describes the mini game *Throw Ball*. The player sees several Living Letters in a landscape, hears the name of a letter, and must throw a ball to the named letter, as in the capture sequence of the mobile game *Pokémon Go* (Niantic, 2016).

![Gameplay loop (left) and storyboard (right) of the mini-game Throw Ball](image)

**Figure 3:** Gameplay loop (left) and storyboard (right) of the mini-game *Throw Ball*

Figure 3 (left) shows the first gameplay loop completed for this game, using the color code we set. In this example, we can easily determine which actions are pedagogical (associate goal info and shape on screen, and locating the letter on screen) and which fulfil purely entertainment related functions (aiming and throwing). It was not, however, always so clear. Each mini game was also illustrated in the form of a storyboard depicting one round of gameplay.

For the mini-game *Maze* (figure 4), we were not able to distinguish purely entertainment-oriented actions from pedagogical actions. The player has to draw a line with her finger along a track, which a racing rocket will follow. The track itself has been illustrated in the shape of the letter being learned. In fact, it seems that all actions embody pedagogical components, but, at the same time, challenge the player with other abilities, such as hand-eye coordination in order to remain in the track.

![Gameplay loop (left) and storyboard (right) of the mini-game Maze (extracts from the briefing document in pre-production)](image)

**Figure 4:** Gameplay loop (left) and storyboard (right) of the mini-game *Maze* (extracts from the briefing document in pre-production)

Using the gameplay loop during the concept phase also helped us to determine that some mini-games did not have an equilibrium between pedagogical and entertainment challenges. For instance, in *Make Friends* (figure 5), the player has to find the common letter in two words. These words, living creatures in Antura, get angry with each other. When the player finds the common letter, the Living Words are reconciled.
In this example (figure 5 left) the gameplay loop shows that the non-pedagogical actions, in blue, are not really ludic. The player simply touches an item on screen without any real ludic challenge. In Make Friends, no abilities apart from the pedagogical ones seem to be challenged. In spite of this, in the context of the production, we kept this mini-game, betting on other aspects to please the children. For example, players might be more focused on the narrative context of reconciliation between two angry Living Words, the animation and behavior of the angry Living Words, or the joy of seeing the Living Words become friends again than on the actual mechanics of the mini-game.

All previous examples come from initial briefings in the concept and pre-production phases. As the development team started to produce the game, we had to modify the gameplay of several mini-games. This iterative design process is a normal process in game production. These modifications impacted the gameplay loops.

The mini-game Throw Ball was problematic: in the first prototype playtest, the children in the test group had issues aiming at the Living Letters properly with the ball. The throwing mechanic on a horizontal screen was not as enjoyable on a vertical screen as it was in Pokémon Go (Niantic, 2016), for example. However, we had to use the horizontal format for Throw Ball, because in Antura, all activities, menus, visual content, and all other mini-games used this screen position. Thus, the team proposed modifying the gameplay by introducing a slingshot (figure 6 right). As soon as the game designer proposed the modification, the gameplay loop was modified (figure 6 left) and the potential effect on the learning/ludic actions was shown.

However, in the rush of production, some changes were not documented. For instance, in another mini-game, Dancing Dots, gameplay changed during the late stages of production, but the gameplay loop was not updated in the documents. However, at the time, we were realizing the final documentation of the game for educators, the gameplay loop was used as a tool of analysis. We were able to create an updated version of the Dancing Dots gameplay loop (figure 7 left) to accompany an illustrated screenshot walkthrough (figure 7 right) comparable to the initial storyboard.
Figure 7: Final analysis of the gameplay loop of the mini-game Dancing Dots (left), and the step by step explanation of the final version of this game (right)

5. Results from an impact evaluation of Antura and the Letters

In 2017, a broad impact evaluation was conducted in Jordan. It was organized by an independent impact study agency (Integrated Services Indigenous Solutions) and funded by several organizations (All Children Reading, the Norwegian Ministry of Foreign Affairs, UNICEF). Its results have been published in a report by Koval-Saifi and Plass (2018). During the study, more than 300 children played Antura in daily 45-minute sessions for seven weeks. The EGRA (Early Grade Reading Assessment) literacy evaluation form was administered before and after the seven-week playing phase to the 366 children playing Antura (treatment group) and to a control group of 383 additional children (control group). Due to the refugee camp context, the attrition between the baseline and the endline was high. The number dropped to 200 for treatment and 202 for control. We should also mention that the Antura treatment group had lower baseline EGRA evaluations than the control group because a majority of these children were from illiterate families (Koval-Saifi and Plass, 2018).

The results of the impact evaluation are positive and demonstrate the progress of the Antura group in literacy, while the control group showed no progress: “the treatment group showed gains in performance from baseline to endline and greater gains in comparison to the control group. Mean scores improved by two to three words/letters for letter sound knowledge, syllable reading, and ORF subtasks. The treatment group showed higher rates of change than the control group from baseline to endline” (Koval-Saifi and Plass, 2018, p. 33). So, despite their disadvantaged family environment, the treatment group progresses (figure 8).

<table>
<thead>
<tr>
<th>Subtask</th>
<th>Group Type</th>
<th>Baseline Mean</th>
<th>Endline Mean</th>
<th>Total Mean</th>
<th>Gain Mean</th>
<th>Rate of Change</th>
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<tr>
<td>Letter Sound Knowledge</td>
<td>Treatment</td>
<td>7.72</td>
<td>14.2272</td>
<td>10.31</td>
<td>16.9379</td>
<td>2.59</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>13.10</td>
<td>17.60739</td>
<td>13.12</td>
<td>18.64871</td>
<td>0.02</td>
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<tr>
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<td>Treatment</td>
<td>4.42</td>
<td>8.47723</td>
<td>6.67</td>
<td>10.2905</td>
<td>2.25</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>7.85</td>
<td>11.90235</td>
<td>8.44</td>
<td>12.59203</td>
<td>0.59</td>
</tr>
<tr>
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<td>2.25</td>
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<td>11.30546</td>
<td>6.46</td>
<td>11.1038</td>
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Figure 8: Results of the Early Grade Reading Assessment evaluation from Koval-Saifi and Plass (2018)
The results for the Oral Reading Fluency (ORF), as shown in figure 9, were particularly strong: “results [...] indicate very low fluency rates among both the treatment and control groups. The treatment group read about half the words than the control group at baseline (3.4 correct words per minute (CWPM), compared to 6.4 CWPM). At endline, the treatment group read 5.8 CWPM, versus 6.5 for the control group. While the treatment group read fewer CWPM than the control group, they had higher gains: children in treatment read 2.4 more CWPM at endline, compared to 0.03 more 43 CWPM for the control group (for further analysis, see Section 5.2.2 EGRA Summary Results). The rate of change for this gain was 71% for the treatment group, as compared to 0% rate of change for the control” (Koval-Saifi and Plass, 2018, pp. 43-44).

![Figure 9: Results of the Oral Reading Fluency evaluation from Koval-Saifi and Plass (2018)](image)

Additionally, qualitative feedback pointed to flaws in the pedagogical structure of the open beta and led the team to reinforce the phoneme and syllable stages in the game. These modifications were integrated in the final version released in March 2018.

The psychosocial impact of playing Antura and the Letters was also evaluated during the Jordan field test. The Strengths and Difficulties Questionnaire (SDQ) was administrated before and after the test period, and shows significant beneficial effects for the Antura players group compared to the control group.

6. Discussion

6.1 Lessons from the use of the gameplay loop methodology in Antura and the Letters

In the context of the production of Antura and the Letters, the gameplay loop methodology provides insights into the design and an explicit visualization of the weight of ludic and pedagogical actions. It also allows developers to understand the impact of game design propositions during the iterative process of playtests and improvements. One of the limitations of the gameplay loop methodology in the way that it was applied in Antura is the difficulty of classifying actions and players’ abilities that are challenged. The vocabulary used to describe actions aren’t framed by rules. Future improvements to the gameplay loop methodology may include creating a more precise basic vocabulary to describe these actions, incorporating requirements from other fields. For example, curricular task lists or explicit cognitive abilities named by pedagogical experts could inform the development of such a vocabulary.

Initially, the gameplay loop was used during the early stages of game development. It is not natural in an entertainment game to update this kind of document throughout later stages of production. A game team normally focuses on prototypes and the actual game, and not on updating the content of such documents.

However, in the development of an educational game, such documentation is necessary. The nature of this tool allows designers to use it to retro-engineer different parts of the game, and then to update the gameplay descriptions even months after their design and production.

6.2 The significance of the gameplay loop methodology for educational game design

In the beginning of this paper, we identified a gap in the literature on serious game design including the neglect of an important unit of analysis, namely the unfolding of gameplay through players’ actions over a relatively short period of time; the lack of a common consideration of game mechanics and learning...
mechanics; and the false separation of playing and learning. In the following, we will outline how the gameplay loop methodology, suggested in this paper and designed specifically for educational games, contributes to the closure of this gap, in other words, what the gameplay loop methodology adds to the field of educational game design.

In accordance with the long-standing theoretical claim that playing and learning cannot and should not be separated (Gee, 2003)—related to the concept of “stealth learning” assuming that players should be “focused not on learning but on playing” (Winn, 2008)—the gameplay loop methodology continuously considers both the target group’s potential actions as well as the target group’s potential learning. The methodology is thus rooted in traditional approaches to serious game design (and their underlying learning theories) that favor endogenous educational games over exogenous educational games. While exogenous educational games (e.g. edutainment titles such as Math Blaster, Davidson & Associates, 1983) “separate learning content and game mechanics” and “insert [...] the content to be learned into the preexisting game structure and rules” whereby “[c]ontent is often the only new input, and the learning tends to be limited to reinforcing knowledge recall”, endogenous educational games “target more complex learning goals beyond memorization and do so in part by integrating learning content into the structure of the game” (Winn, 2008; see Halverson, 2005). The methodology thereby reacts to one major criticism towards serious games in general and educational games in particular: “the inadequate integration of educational and game design principles” (Arnab et al., 2015, p. 392). Overall, we aspire to achieve a comprehensive merging of game design and instructional design.

In addition to addressing this call to consider both gameplay and learning (derived from digital game-based learning theories), we also comply with a claim by player research and user-centered design: that the player should be considered throughout the development process. In this sense, the gameplay loop methodology is similar to the MDA model used for the design of entertainment games, which also strongly emphasizes the player’s perspective (Hunicke, LeBlanc and Zubek, 2004).

The gameplay loop methodology offers an approach to design that focuses on both game mechanics and learning mechanics. It allows a close monitoring of the interconnections between gameplay and learning at the micro level of players’ actions. In contrast to other serious game design methodologies, it is particularly catered to cover educational games. We assume, however, that in practice the gameplay loop methodology should be complemented by other approaches. As the methodology takes the view of the game design department, other more holistic frameworks, such as Mitgutsch and Alvarado’s (2012) SGDA framework, could be applied to consider the perspective of other departments (such as the art department) in order to achieve a well-rounded game that is as aesthetically and mechanically appealing as commercial off-the-shelf games and allows its players a learning experience related to an educational domain beyond the game itself, building on the unique learning possibilities of play and games.

7. Conclusion

Over the course of this paper, we have suggested the gameplay loop methodology as a valuable tool for the design of educational games. Using examples from the design and production of Antura and the Letters, a literacy game for Arabic refugee children, we have demonstrated the practical usefulness of this methodology—with a focus on gameplay and learning—for educational game design. We have also described how the gameplay loop methodology is situated in a broader educational game design approach—including the application of methods from player-centered game design as well as the consideration of knowledge from domain-specific didactics (in this case Arabic language pedagogy) which is rarely emphasized in other educational game design methodologies. Overall, we have argued that the methodology contributes to the closure of a gap in the literature on methodologies for the practice of educational game design because it focuses on the unfolding of gameplay through players’ actions over a relatively short period of time as a unit of analysis, considers game mechanics and learning mechanics in their interdependencies, and thus merges playing and learning on a micro level. We then summarized results from an impact study, which show that the desired union of playing and learning has been successful in the case of Antura and the Letters.

However, the empirical evidence for the usefulness of the gameplay loop methodology when it comes to the design of educational games that initiate a unification of playing and learning is insofar limited as the presented case study represents only a particular form of educational games, i.e., a series of meaningfully connected mini-games relying on cognitive theories of learning. Future empirical studies should verify the
usefulness of the methodology across genres and pedagogical approaches. They should furthermore go beyond the single case study design as well as systematically compare the methodology’s design processes and outcomes with those of other methodologies.

Future conceptual works should, among other things:

- create a more standardized and comprehensive vocabulary to describe players’ actions and learning—building on knowledge and language from disciplines such as educational sciences, learning sciences, and cognitive science as well as particular curricula from different areas of education, starting for instance with Bloom’s taxonomy of educational objectives (see Bloom and Committee of College and University Examiners, 1964, and Anderson et al., 2001);
- apply the gameplay loop methodology to different genres of digital (educational) games as well as to serious games in general;
- outline ways in which the methodology can be combined with and/or embedded in other more holistic frameworks (including the perspectives of game artists and game programmers);
- and reconstruct instructional strategies and learning theories that can be found in games designed with the methodology (which might be supported by the nature of the methodology) and subsequently add features to the methodology that allow designers to distinguish between and reflect on different instructional strategies and learning theories.

Acknowledgements

We would like to thank Elaine Chen and Alexandra Petrus for their valuable editorial assistance in the preparation of this article. This research project received funding from the Norwegian Ministry of Foreign Affairs as part of EduApp4Syria innovation competition. The impact test evaluation was supported by All Children Reading and UNICEF.

References

Davidson & Associates (1983) Math Blaster! [C64] [PC], Apple, Atari.


Educating for co-Production of Community-Driven Knowledge

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Abstract: In this paper, we present the project, Community Drive, as well as the theoretical and empirical background on which the project is based. Through technical and humanistic collaboration, the project aims to create models that allow children and young people to participate in overcoming future challenges in cities by becoming active and contributing participants in research and development efforts. Further, the project contributes knowledge about community-driven game tools, user-driven big data and the Internet of Things and their connection with intelligent and socially responsible urban development. The project is conducted in cooperation with the city of Copenhagen, local schools and Aalborg University. Community Drive involves students, aged 10–13, attending schools in deprived neighbourhoods near Aalborg University Copenhagen in southern Copenhagen. This area is characterised by a high rate of unemployment, low income and residents with little or no education. As a result, resources have been allocated for reconditioning the subsidised housing in this area. In this paper, we discuss the ways in which Community Drive, initiated in May 2018, is based on the results of pilot projects conducted from 2014 to 2017. Overall, these studies showed that tasking students with changing their living conditions by redesigning their neighbourhoods is a strong motivational factor. During the redesign process, students were able to construct game-based models of various residents’ needs and argue for redesigns based on their knowledge about the area and the ability of certain designs to fulfil the needs of various groups of residents living in the area. We also present initial results from collaboration workshops between schools and professional external local partners. These results show that three themes are central for the collaboration process: building local contact, meaningful local ownership and real challenges and applicable solutions.

Keywords: community-driven research, urban development, citizen science

1. Introduction

Schools and educational institutions do not adequately educate students to engage in independent knowledge collaboration and solve complex societal challenges (Bundsgaard and Hansen 2016; Slot et al. 2017). As an alternative strategy to formal learning, community-driven research can break the boundaries between research institutions and surrounding communities through the involvement of new types of actors, forms of knowledge and institutions (OECD 2011). Involvement of citizens and communities beyond universities and traditional research institutions as participants in research systems has been defined as a megatrend that will influence future research policy (Barreneche et al. 2016). There is an increasing focus on how laypeople and communities outside traditional research institutions can be involved in all levels of research activity, including data collection and categorisation. In the field of learning games, and specifically in the development of science game formats, the ability of games to introduce new approaches to authentic science education has been the main topic of focus (Gee 2007). The field of learning games was inspired by new types of games in which players are invited to participate in real-life professional research processes rather than simulations (Cooper 2015; Magnussen 2017). The development of so-called citizen science games, or scientific discovery games, within the past few years has introduced new elements into the issue of game-based participation in the knowledge domain. The main goal of this type of game is to create a platform that enables and motivates players to help solve scientific problems. This paper presents the project, Community Drive, a three-year cross-disciplinary community-driven game and a data-based project in which students collaborated with urban planners to redesign their neighbourhood by applying game tools and sensor technology.

2. Background

Community Drive addresses extensive scientific and societal challenges regarding the integration of research and education in elementary schools, cooperation across institutions and openness and access concerning the way research is conducted. The project is intended to create a new field of interdisciplinary research based on community-driven research defined here as research that is produced, communicated and applied in cooperation with non-academics and is based on citizen involvement and openness from the earliest phases of problem formulation to the final phases of implementation and evaluation. Community-driven research is
inspired by experiments in open science, open data, open methods and open-method citizen science, but goes further and establishes future and shared-engagement knowledge communities with external actors.

Specifically, the project addresses three challenges regarding the movement towards greater openness, community and impact in the research world. Next, we will briefly outline the three challenges the project addresses.

2.1 Opening schools and measuring competencies in Community Drive

The first challenge is the development of future education and student skills in solving complex problems. The need to identify which competencies will be key in the future has been the subject of education policy debate for several years (Griffin et al. 2012; Dumont et al 2010; Greenstein 2012). One proposed type of competence involves the so-called ‘21st century skills’, which are derived from a number of fields and include skills related to learning, innovation, information, media and technology (Partnership for 21st Century Skills 2004). Research has partly focused on defining and redefining competencies and curricula (Dede 2010) and partly on developing methods to evaluate 21st century skills (Voogt and Roblin 2012). In this project, a range of tools were developed based on cases involving 21st century skills. Citizen awareness and innovation and learning skills are highlighted as key conditions of collaboration between students and actors across institutions and disciplines. The project thus involves both theoretically-based learning design as well as competency assessment tools, addressing the need to develop theories, definitions and tools for community-driven research in elementary school education. The strategic background for this research effort can be found in the Danish school reform, ‘The Open School’, which requires schools to be more open to society and cooperate with actors outside the schools (Christiansen et al. 2015). Early studies, however, showed that Danish elementary schools insufficiently educate children and young people to self-produce knowledge and solve authentic, complex problems (Bundsgaard and Hansen 2016; Slot et al. 2017). A central part of opening schools to community-driven science is the inclusion of game tools for the development process. This will be discussed later in the findings session.

2.2 Opening the research community

The second challenge the project addresses is the development of a more open and engaging research community. In recent years, research policy institutions, such as the EU Commission, the Organisation for Economic Co-operation and Development (OECD), and a number of private research funds have focused on new practices for open research and innovation have encouraged non-academics to participate in the research and development process (Barreneche et al. 2016). These open ‘quadruple helix’ collaborators involve representatives from research, businesses, government authorities and civil society and are considered in a number of publications to be the key for greater and more responsible use of research knowledge (OECD 2011). Open research is, first and foremost, a research agenda that can have a greater impact on society.

Although at first it was primarily related to scientific publishing (open access), increasingly, more open research has aimed to encourage knowledge sharing and involvement among users (OECD 2011; Geoghegan-Quinn 2014; European Commission 2014; Budtz Pedersen and Martiny 2016). The research policy agenda is based on the finding that scientific knowledge has the greatest possible impact in a society in which citizens, businesses and stakeholders are invited to participate in research as early in the process as possible. This finding is emphasised by the strong increase in diversity and the amount of open data that is available from public authorities. Previously, specialised expertise was required to analyse big data, but now there are more examples of tools that allow citizens and other laymen to independently perform big data analysis (Marr 2016).

A number of challenges must be taken into account when open data is used in community-driven research, such as challenges related to data quality, bias in data and transparency in tools (Allan and Redden 2017; Martiny, Budtz Pedersen and Birkegaard 2016). One example can be found in research using game elements and involving participants who contribute to the development of knowledge and solutions, also known as ‘scientific discovery games’ (Good and Su 2011; Cooper 2015). These studies show that the involvement of children and young people in teaching has great educational potential and that there is strong motivation for students to participate in authentic research and development processes in collaboration with professional actors (Magnussen et al. 2014). At the same time, reviews show that this type of community-driven research is largely defined by research, not participatory needs, and that laymen are often included in complicated
research processes without development of their competencies (Magnussen 2017). Community Drive investigates how collaboration can be based on both citizens’ expertise and professionals’ skills.

2.3 Opening urban development to actual citizen involvement and influence through access to city data

The third challenge addressed by the project is the city’s big open data and citizen involvement in urban development. Sensor technology and data have been given a central role in the development of cities in recent years. The smart city and smart society are well-known concepts related to information and communication technology (ICT) and the collection of information about the city’s status, which, in collaboration with citizens, can be used to optimise resources and offer citizens new and better services (Ojo et al. 2015). In a smart city, it can be difficult to ensure citizen privacy when information is collected (Gidari 2017). Smart citizens are defined as citizens who use open sources or their own ICT to investigate other citizens’ experiences regarding one or more parameters. Citizen measurements may be based on climate-related measurements of citizen mobility and use of urban space. Community Drive focuses on the many types of data obtained in a city and the way in which one can enable citizens to collect relevant data about the city. Use of the city use and its inhabitants. In particular, it examines studies of how existing data can be represented and applied by both students and other actors. This contributes to the development of not only smart cities but also smart citizens, which is important because the potential of the smart city is best realised by citizens cooperating with urban developers and planners.

In a recent mapping review of status and trends in research of citizen science, crowdsourcing or community-driven research from 2013–2018, 15 themes were identified through an analysis inspired by grounded-theory: 1) motivation, 2) evaluation, 3) education and learning, 4) man-machine collaboration, 5) participant experience, 6) impact on research, 7) CS technologies, 8) big data, 9) system or project design, 10) social media, 11) participant development of research, 12) behavior, 13) ethics, 14) cross-disciplinary partnerships, and 15) organizational change (Magnussen and Stensgaard 2019). The review was especially focused on identifying themes with a focus on traditional educational activity and new forms of learning in the field, and revealed central discussions on the potentials of technology in citizen science learning and application of new types of technology. Results related to citizen science learning showed that value is added into knowledge generation by the collective process of a group with multiple competencies. This is specifically through two processes: social learning and learning from experience. These results indicate that it is central to focus on defining the skills of various groups of participants when designing citizen science projects and determining what processes users are able to participate in and what additional training or education is needed for participants to contribute to more sophisticated processes. The review also reveals that technologies will play an increasingly greater role in crowd sourcing in both research and business, and there are central discussions on whether the active input and participation of users will be transformed to more passive inputs with involvement of passive sources of data generated by existing and new types of sensor technologies, bots, artificial intelligence and other types of technology (Magnussen and Stensgaard 2019). The review results are central in relation to developing community-driven research in the presented project Community Drive.

In summary, the goal of Community Drive is to develop a model for establishing comprehensive game- and data-driven research and development cooperation, focusing on the education of children and young people in community-driven research. The project thus aims to create a new research platform and approach based on research co-produced with children, young people, professionals and a municipality. It aims to answer the following research question: Through game- and data-driven methods, how can children and young people develop the competencies needed to participate in the development of technical and humanistic scientific solutions for a city’s complex problems in cooperation with professional actors? In the following sections, we describe the hypotheses and approaches on which Community Drive is based and present and discuss the results of previous pilot projects. Finally, the first results from collaboration workshops between teachers and professionals in the deprived neighbourhoods where Community Drive is running in are presented.

3. Methods

Previous pilot projects—specifically, the so-called City at Play project—were developed in close collaboration with the Copenhagen City Council Social Services Department and Aalborg University Copenhagen. The project aimed to involve young people in deprived areas as experts on their own living environments and to educate them on the influence of structural factors on their welfare and well-being and on how to use game tools to
apply their knowledge and ideas to recreate and strengthen their neighbourhoods (Magnussen and Elming 2017). From the start, the project was intended to define problems and introduce game-based methodological solutions to implement structural changes in neighbourhoods in deprived areas of Copenhagen, addressing both social and educational objectives. The project aimed to provide real-world contributions to the City Council’s urban development and planning and, ultimately, help to realise some of the presented ideas.

The methodology used to develop the components of Cities at Play followed a design-based research process involving various design cycles, interventions, analyses and redesigns (Brown, 1992). Design-based research was applied as a methodological framework, and various methods were employed to develop and study the game-based community-driven urban planning environment. The project involved two iterations of a design-based research process (Brown 1992) that involved an increasing number of school classes and departments of the Copenhagen City Council. The first iteration is described in another paper (Magnussen and Elming 2017).

3.1 Study design, methods and data analysis in Cities at Play

Cities at Play included four teachers, two seventh grade classes and two ninth grade classes (in total, 90 students aged 13–15) from a school in a deprived area of southern Copenhagen. This area was chosen due to its high rate of unemployment and its residents’ limited or lack of education. The school is located in an area with older public housing that suffers from problems involving gangs and drugs. A library, nursing home and kindergartens are near the school. The project was conducted in the local library over a two-week period. The classes worked separately on their models for one week and then worked in parallel during the second week to finish their models for presentation to urban planners from the technical department of the city of Copenhagen. A mixed-methods approach was used. Video observations were used to document the weeks of student design sessions, particularly student dialogue in the design process, to understand how various models were developed and the types of local technical knowledge that were used to do so (Brown and Wyatt 2010). Specifically, the video observations focused on elements that strengthened students’ competencies.

Pre- and post-surveys were conducted to measure students’ motivation to participate in the project, local knowledge about the area and urban planning, how well the project supported learning of 21st century skills such as real-world problem solving and collaboration compared to what students defined as ‘everyday school’, how much the project differed from ‘everyday school’ according to students and students’ understanding of their ability to structurally change their living conditions. The digital surveys provided opportunities for quantitative answers, which created an overview of the students’ knowledge and experiences, as well as for qualitative answers, which clarified the background for the quantitative answers. The teachers administered the surveys to their classes the day before the course started and on the day the course ended. Semi-structured qualitative interviews with teachers and students were conducted to reveal the possible outcomes and challenges of the project (Brinkmann and Kvale 1996). Qualitative data were analysed, applying grounded theory as a method of data categorisation, and themes were defined based on participant-defined concepts related to perceived knowledge generation and learning practices (Strauss and Corbin 1998). The intervention phase of the project is structured around two design-based iterations, and the teaching design is based on the results of the project mapping phase, developed, involved in interventions, analysed, redesigned and tested based on the results of the analysis.

3.2 Study design, methods and data analysis in first workshops in Community Drive

Section 5 in the current paper presents the first results from two collaboration workshops done with teachers and professionals in the deprived neighbourhoods where the project was conducted. A total of 30 teachers from two schools participated in the two workshops conducted by researchers at Aalborg University Copenhagen; teachers were invited into the university facilities to develop courses for students in collaboration with researchers and the external professional partners for whom the students were to solve challenges. Each workshop was planned for five hours of hands-on activities including introduction to design thinking as the structure for developed courses and collaborative development with local partners for ideas involving students in solving challenges. The two workshops were conducted at Aalborg University in February and March 2019. Workshop 1 focused on introducing teachers to design thinking (IDEO 2009), and Workshop 2 focused on initiating collaboration processes between teachers and professional local partners and supporting development of first ideas to courses for students.

Based on the researchers’ previous experiences with collaborating with teachers, a hands-on approach was chosen in the introduction of design thinking as didactical structure (Magnussen and Elming 2017). For the
workshop structure, this meant that the attending teachers got to try first-hand how the methods work. An example of this was a facilitation of an adapted version of an introductory Design Thinking material ‘The Wallet’ (https://dschool-old.stanford.edu/groups/designtoolkit/wiki/4dbb2/the_wallet_project.html). A revision was conducted of the original focus (the wallet) and was adapted to a school context by focusing on a school bag instead. The teachers tried every step of a development of a prototype of a school bag culminating in the production of prototype bags. In Workshop 2, the focus was on dialog between teachers and professionals about collaboration. The group of researchers had arranged for external professional partners to participate in the workshop, and dialog tables were set up for teachers to circulate and discuss ideas for involving students in solving local problems as part of their school education as an approach of introducing both design thinking and partnership involvement in curriculum. This method of introducing new methods and curriculum is characterized as an experimental design (Cobb et al. 2003). DiSessa and Cobb (2004) compare this type of approach as building the plane while flying, which corresponds to the collaborative nature of this particular work, where inputs from shifting actors add and form the collective knowledge.

Workshops were documented through video observations and audio recordings and the themes presented in Section 5 this paper were developed through a thematic analysis of qualitative data from observations from workshops with teachers and professionals (Braun and Clarke 2006).

4. Findings in pilot studies in Cities at Play

As described in previous sections, the three-year research and development project Community Drive builds on previous pilot studies, such as City at Play. In this section, the central findings and potentials and challenges of the pilot studies will be discussed in relation to the research approach of Community Drive.

4.1 Structure of courses and educational approach – design thinking

The design of Cities at Play: Community Drive included five phases and was based on the results of previous studies on game-based innovation education and community-driven science games (Magnussen et al. 2014).

As described in Table 1, the participating students progressed through the following phases: 1) inspiration, 2) identification of the opportunities and problems in their area, 3) development of ideas and building of models in the game, Minecraft, and with other materials and 4) presentation to and feedback from professional architects and urban planners from the Copenhagen City Council departments. In this section we present results from the pilot studies: Cities at Play.

4.2 Competencies: Real-world problem solving and community-driven urban development

Pre- and post-surveys of students’ developed knowledge were conducted in the pilot project, City at Play. These surveys investigated how students perceived the tasks and how they differed from other project-based teaching tasks as well as what type of knowledge students think they develop during the course. The surveys indicated that a majority of students (78%) believed that the overall focus of real-world problem solving in City as Play was different from that of everyday schoolwork (Magnussen and Elming 2017). When asked what was different, students provided various responses, which can be categorised into several themes (see Table 2).

Table 2: Themes of responses to the two post-survey questions regarding City at Play: ‘Were the problems you worked with in City at Play different from the problems you normally work with at school?’ and ‘What was different in City at Play compared to everyday teaching?’

<table>
<thead>
<tr>
<th>Themes</th>
<th>Examples of student responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changing things</td>
<td>‘Yes, because we normally don’t work with changing things’. ‘Yes, because we were working with changing something in our city, which is something we don’t do in class’.</td>
</tr>
<tr>
<td>Something in the real world</td>
<td>‘Yes, a lot, because it concerns the real world and it involved problems we could solve for the entire neighbourhood’. ‘Yes, because in a way, it did not involve problems related to school subjects but something in the real world’.</td>
</tr>
<tr>
<td>Helping people, not just working for your own benefit</td>
<td>‘In school we work more for our own benefit. In City at Play, we made something that everybody could benefit from’. ‘In school you need to improve your grades, here we needed to help other people … #Thatwasnew’. ‘Yes, because we had to consider whether it would work because here it’s all about people’.</td>
</tr>
</tbody>
</table>
Themes | Examples of student responses
--- | ---
More freedom to make decisions/not predetermined | ‘What we had to make was not predetermined’. ‘It’s kind of good because we had to decide on what we needed to build and so on. It’s not like that in daily teaching, where teachers have the right to decide’. ‘We were allowed to determine/decide most things’.
Using one’s imagination and inventing | ‘We had to use our imaginations’. ‘We don’t usually talk to architects and invent things’.
Being active | ‘We didn’t sit down all the time’. ‘You were free to choose what to do’. ‘We got to move around and independently decide things’. ‘We were active in City at Play’.
Other tools | ‘We used other tools’. ‘We had to play a game to do our assignment’. ‘We were building with LEGO blocks and made models with them’. ‘No books, a lot of collaboration’.

The central focus of Community Drive is assessment of the competencies students develop in a community-driven research environment with a design-thinking approach. It is supplemented by assessment of the competencies students develop through participation in complex, authentic problem solving. Through collaboration with the project GBL21 (GBL21.aau.dk), the project develops a unique quantitative competency measurement tool to test which 21st century skills students develop during complex, authentic problem solving. The competence test is developed as a series of scenario-based modules that are standardised through Rasch analyses and is based on previously developed tools (Bundsgaard and Hansen 2016).

### 4.3 Documenting and representing local knowledge

A central aspect of Community Drive and previous pilot projects has been visualisation and representation of students’ knowledge and developed ideas so they have an impact on formal decisions made by the city of Copenhagen regarding particular areas. To do so, the study has identified how students perceive their knowledge and how it can contribute to development of the area. In the project’s pre- and post-surveys, students were asked if they had knowledge about their area that the urban planners participating in City at Play did not possess. In the pre-survey, 9% answered either ‘Yes, I know a lot that they don’t know’. or ‘Yes, I know a bit more’. This percentage changed to 45% in the post-survey (Figure 3).

**Figure 1:** The bar chart on the left shows the pre-survey results, and the one on the right shows the post-survey results.

The pre-survey question was, ‘Do you have knowledge about Folehaven that the architects redeveloping Folehaven do not have?’ In the pre-survey, 7% (green) answered, ‘Yes, I know a lot that they don’t know’; 2% (light blue) answered, ‘Yes, I know a bit more’; 26% (orange) answered, ‘Yes, some’; 38% (dark grey) answered, ‘Maybe a little’; 17% (dark blue) answered, ‘No, not very much’; and 10% (light grey) answered, ‘No, not at all’.

Students answered a similar question in the post-survey: ‘Think about the City at Play course. Did you possess knowledge about Folehaven that the architects redeveloping Folehaven did not have?’ Ten per cent of the students answered, ‘Yes, I knew a lot that they didn’t know’; 35% answered, ‘Yes, I knew quite a bit more’;
23% answered, ‘Yes, some’; 16% answered ‘Maybe a little’; 6% answered, ‘No, not a lot’; and 10% answered, ‘No, none at all’

These results indicate that the students’ perceptions of their knowledge about their neighbourhood and how it compares to that of professional urban planners changed after participating in the pilot project. The study closely examined this change, asking students to qualitatively specify the knowledge that they felt urban planners did not have. The analysis of the data showed that the participating students had specific knowledge about physical buildings or facilities in the area, experiences or feelings in relation to living in the area, experiences or feelings related to specific locations or facilities in the neighbourhood, and social aspects and needs of the community. These areas of citizen knowledge are central in the development of the future project, Community Drive.

5. Collaboration between schools and industry and organisations in Community Drive

This section will first present the results from collaboration between teachers at schools in deprived areas and professional local partners outside schools. As described in the methods section, the workshops were planned as hands-on introductions to the central methodological framework in Community Drive—design thinking and local partnerships. In two workshops the teachers and professional partners developed ideas for courses where students could solve authentic problems through a design thinking process including phases of exploration, interpretation, ideation and experimentation (IDEO 2009). Workshop 1 was focused on introducing teachers to design thinking in education by involving them in a hands-on run though of the design thinking process. At Workshop 2, both teachers and professionals form industry and organisations in the local area participated. Before the workshop, the professional partners, in collaboration with the researchers in the project, defined the problems that they needed the pupils help to solve. The three cases were: developing the local café with youth-friendly activities and healthy food, helping build models for new facilities at the local cultural centre and helping develop ideas and models for a future public sports centre that the city of Copenhagen is planning in collaboration with several organisations. At Workshop 2, teachers and professionals met for the first time and discussed cases and how to involve pupils in solving tasks in relation to the subjects teachers were teaching: science, math, mother-tongue language and creative and design subjects. Overall, the workshops, and especially the hands-on approach, was received very well by both the teachers and the professionals. One teacher expressed this in the evaluation of the workshops: ‘I think it was really great to do all this by hand and trying all of this on yourself’ (Participant 3, Workshop 1). Another teacher pointed out how this approach supported the transfer of the content of the workshop to the classroom and work with students: ‘It also makes it easier to understand the obstacles the students will face when they try the material’ (Participant 8, Workshop 1).

In this section we present the initial results from data analysis of video observations and audio recordings of collaborative activities in the two workshops. The outcome of this work is still in progress, and the teachers are designing new materials where they incorporate both partnerships and design thinking elements in the curriculum for 2020. The themes presented in this paper were developed through a thematic analysis of qualitative data from observations during the workshops (Braun and Clarke 2006).

Table 3: Overview of the identified themes and sub themes

<table>
<thead>
<tr>
<th>Themes</th>
<th>Examples of workshop attendee responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Building local contact</td>
<td>‘The real problem is, as a matter of fact, that we currently do not have any local partners. So if we were to go out and create a contact with a local partner, and ask them to contribute with concrete challenges, then a local webpage could be created’. (Participant 7, Workshop 1)</td>
</tr>
<tr>
<td>2. Meaningful local ownership</td>
<td>Participant 9: ‘(…) using partners in the local areas we are in and the partners there, instead all of us wanting to work with the newest and the hottest’. Participant 8: ‘Yes, and it is places they [students] use all the time, which helps them to see what they have created’. Participant 7: ‘Keeping the ownership’. (Participant 7, Workshop 2)</td>
</tr>
</tbody>
</table>
The main focus in the study and themes presented in this section are to investigate teachers’ perspectives in the collaboration process of didactic development of student collaboration with industry and organisations.

5.1 Building local contacts

This theme depicts the current practice of the teacher’s involvement with local partners. From the teachers’ perspective, barriers in the collaboration is both to create contact with local partners and to find common projects that engage both students and partners. As Participant 7 said:

*Participant 7: ‘Because there needs to be some sort of motivational factor related to have partners report the problems or challenges they face. And if the challenge is not real, if real solutions are not applicable, then they are less likely to join in’. (Participant 7, workshop 1)*

Teachers also expressed how collaboration requires resources from schools and partners, which makes it central that both parties’ experience benefitting from the collaboration. Participant 3 said:

*I believe it takes up a lot of resources to involve one entire class. We could involve some students, but one entire class visiting, teaching, we need to make a project that they (external partners) also find relevant to give something back and forth. It relies more on willingness and giving back to the community. Or helping the development, because they (external partners) find it cool and exciting.* (Transcripts of video observations, Workshop 1).

Resources involve a multitude of aspects. The teacher above mentions both time and convenience in relation to field visits, etc. These extra resources are needed from both the school and the partners. In relation to visiting partners and the use resources when planning these types of field trips for young students generally requires two teachers. In reality, this means the use of a substitute teacher or somehow coordinating visits within a specific timetable. The teacher quoted above is also concerned about the resources used by potential partners. Having a whole class visit can take up a considerable amount of space and resources. A survey between a random sample of 305 principals from all over Denmark also noted a lack of contact between Danish primary schools and other actors, such as companies. The report where the survey is published concludes that there is a willingness to include more collaboration with companies, but it also notes the obstacles for these types of partnerships are the creation of contact and, moreover, making these types of collaborations contribute to the students competencies (Skolelederforeningen 2017).

In summary, the main insights are that the participating teachers have a lack of contact with partners and that both creating and maintaining these relationships are resource demanding for all parties involved.

5.2 Meaningful local ownership

The theme of local ownership and the importance of connecting school work to the student’s imminent environments was a central theme in the discussion from the teachers’ perspectives. One example is this dialog on how students working with local challenges and developing local elements are central:

*Participant 9: The United Nations put up a lot of challenges, then thousands applied there instead of using partners in the local areas we are in and the partners there, instead all of us wanted to work with the newest and the hottest.*
Participant 8: Yes, and it is places they [students] use all the time, which helps them to see what they have created.
Participant 7: Keeping the ownership.
Participant 8: Yes exactly. It’s their immediate environment that have improved.
Researcher: It becomes a point that the development is visible?
Participant 9: At least that is what makes it meaningful and makes it relatable to them. I think that they have not helped with something out in Nordhavnen [somewhere far from the school] or what do I know? (Transcripts of video observations, Workshop 1)

The notion of local ownership is from the teacher perspective highly linked to the fact that students work with partners in their surroundings, which gives the students the opportunity to see changes they have contributed to first-hand. The sense of responsibility is bi-directional in regards to the local ownership. The partners contribute to schools in their neighbourhoods and the school contributes by participating in solving problems and tasks. This understanding is in line with community science with regards to how local ownership should be viewed (Wandersman 2003). Summarizing this theme, the main insight is that the kind of partners the teachers are interested in establishing a relationship with are actors that are located in the immediate environment, that is, within walking distance to the school. The reasoning behind this is that students can see first-hand what they have contributed towards and the practical matter of making visits are feasible with partners that are located near the school.

5.3 Real challenges and applicable solutions

Another theme that emerged from the data revolved around future collaboration between schools and partners. The outcome for potential partners from industry and organisations involved in the process was of great importance to the teachers:

Participant 7: Our real problem is whether or not they [the partners] get an actual benefit from participating.

Researcher: Why is it important that they have a real benefit?

Participant 7: Because there needs to be some sort of motivational factor related to having partners report the problems or challenges they face. And if the challenge is not real, if a real solutions is not applicable, then they are less likely to join in. (Transcripts from video observations, Workshop 1)

From this teacher’s perspective, the collaboration hinges on solutions of what teachers calls ‘real challenges’ and ‘real solutions’. This correlates with the general adopted stance on how problems are viewed within a problem-based learning environment (Dirckinck-Holmfeld 2002; Kolmos and Graaff 2003; Ryberg 2019).

Another aspect of the authentic collaboration is what the partners involved in this type of partnership gain. Looking at the responses from the teachers, this seems to be a priority:

Participant 7: But there needs to be some kind of [reward]. If it can strengthen a company’s image being represented on the list, and because they [local partners] contribute with challenges locals can solve, but this also needs to be public available.

Participant 8: Then the schools can add what they have participated in, and then [the school] get their name on the list. That they have contributed to urban development here (...) to give a local ownership, for both local partners and the students as well (...) they [the partners] can also show that they contribute to these projects and that they actually take part in students learning and urban development. (Transcripts from video observations, Workshop 1)

These teachers make references to the idea of creating some kind of collaborative tool (e.g., a website) where partnerships between schools and other actors are both facilitated and communicated. The idea is that companies and schools would benefit from being present on such a platform. Summarizing the theme, the main insights are that teachers are seeking authentic challenges and related to this, the need for the student involvement to solve these challenges and that partners actually have an authentic need to gain student
insights and points of view. What is also central in this theme is that teachers are aware that students should produce solutions that are applicable for professional partners. This requires close collaboration between schools and partners in planning what types of outcomes challenges require. Focus in this collaboration needs to be on several aspects, such as formats of solutions (e.g., paper and digital versions), and choice of tasks in relation to level of knowledge required for producing applicable solutions for professional partners.

6. Discussion and conclusion

The current paper has shown how collaboration between young students in deprived areas and professional urban planners can lead to both knowledge building and students’ enhanced understanding of their own expertise. The pilot studies, however, also showed that models built by students had very little impact on the decision making in the departments involved in developing the area (Magnussen and Elming 2017). To understand this finding, Community Drive further investigated which forms of knowledge and knowledge processes can impact students’ knowledge. Part of this is integrating new types of documentation of students’ access to the Internet of Things, using sensors and trackers to document challenges and opportunities in their neighbourhoods and access to technical, social and socio-economic big data from the city of Copenhagen. In addition, the project’s activities focus on providing children and young people access to the city’s big open data and live data, which were measured, documented and represented by young citizens. As a starting point, access to the city’s data allows students to access a wide range of information, such as data about traffic, pollution, light and use of different areas, which is essential to the development of their city and neighbourhood. These data-driven approaches will be central in the future studies in the Community Drive project.

In this paper, we also presented the first processes of collaboration between schools and professionals outside schools in planning student processes of solving authentic problems in the city of Copenhagen. The reported results from workshops show that there are several central focus points in collaboration between schools and local partners: building local contacts, meaningful local ownership, and real challenges and applicable solutions. In the analysis, it became clear that teachers find it central that collaboration be didactical to develop as what can be defined as ‘local problem-based learning’ where teaching centres on solving authentic problems in the school’s local environment. This is to establish local ownership through students’ development of solutions that becomes visible and present in their local neighbourhood. These aspects of local ownership are closely related to themes of creating local contacts and creating authentic challenges and solutions; teachers were extremely focused on the notion that challenges should be real in the sense that partners need solutions to them. What also become central in the data is that students should produce solutions that are applicable for professional partners. This requires close collaboration between schools and partners in planning what types of outcomes the challenges require. Focus in this collaboration needs to be both on several aspects such as formats of solutions (e.g., paper and digital versions), and choice of tasks in relation to the level of knowledge required for producing applicable solutions for professional partners.

Working within the cross field between the academic world and praxis brings forward a great deal of reflection. The overarching goal of Community Drive is to bring university, school and professional partners closer together with a humble hope that such collaboration will bring mutual benefits. However, looking at the history of community capacity building, the vision of what is helpful is quickly blurred (Chaskin 2001; Graig 2007). In relation to the theme, lack of contact and resources, the dynamic comes into play when teachers who participated in the workshops talked of a missing relationship with the surrounding area. One possible reaction is that this lack of contact is a gap that universities might be able to bridge. Another issue is that the teachers need experiences of how to involve external actors in their curriculum. However, we might bridge these gaps and create new contacts, but we must also continuously reflect on our own position in relation to the participating parties. These aspects are central in developing common community tasks and collaboration practices for solving them in school—industry collaboration in future community-driven research studies.

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References


