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GAME-CENTRIC PEDAGOGY AND CURRICULUMS IN HIGHER EDUCATION

Abstract:

This paper examines some recent trends in game-centric education for STEAM (science, technology, engineering, art and mathematics) fields, especially those that explore and promote collaboration among multiple disciplines. We discuss various multimodal design research activities that draw upon the applications and usage of popular technical hackathons and game design jams in educational environments. The intent of this work is to guide and inform new approaches to the core components of STEAM curriculums.

Game-centric methods appear to be well-suited to a variety of education and training circumstances, particularly those that apply in transnational settings and/or serve highly diverse student populations. The benefits extend beyond the direct game-building activity; for example, the process can promote broader design thinking skills and encourage better appreciation of the typical understand-create-deliver flow process, which may be found in many different contexts. Other advantages can include the encouragement of critical thinking skills, the ability to safely tinker and experiment, and the empowerment to fail and start over. In these respects, we view game-making as a form of 'future-making', and thus a valuable vehicle for enhancing general education and long-term life skills.

We conclude by describing some opportunities to undertake qualitative and quantitative research on teams of participants in popular game development events, such as the multinational Global Game Jam (GGJ) series. This process involves examining their background demographics, and characterizing the team dynamics and behaviors in the context of their game design and development activities during the game jam.

Keywords:

Game-making pedagogy
Transnational multidisciplinary learning and teaching
Science, technology, engineering, art and mathematics education

JEL Classification: I20, C71, O31

Introduction

Many universities seek to be identified as locations for technological innovation and creativity through combining academic knowledge, entrepreneurial spirit and design practice. This vision is often manifested as initiatives to encourage student participation in projects that move education beyond the campus, conduct research in participatory communities (Aaen & Nørgård, 2016) and/or engage in academic citizenship as active professionals and citizens in society during their education (Nørgård & Bengtsen, 2016). Such initiatives have become part of the mandate for many institutions of higher education (for example, see Fung & Carnell 2016). However, they are often hindered by a "walled garden" mentality whereby students and faculty are secluded in a home department and rarely undertake cross-disciplinary academic work or conduct research and create products with scholars or people outside their colleges (Aldrich, 2014; Lattuca, 2001).

Recently, student makerspaces, design studios, hackathons and game jams are often seen as promising environments, formats and processes for developing and promoting proactive students, who are capable of acting upon their academic knowledge in innovative, critical reflective and designerly ways (Barrett et al., 2015). Such spaces and processes are characterized by inviting people to tinker, experiment, take risks, be playful, get novel ideas and externalize thinking through making. They have been introduced into curriculums across STEM (Science Technology, Engineering and Mathematics), Arts and Humanities, and Business Management, among others. They encourage students to take chances, think differently, externalize and materialize ideas that give them tools, experience and competencies to encapsulate their ideas in the form of designs, such as games. This is often done in group-based, cross-disciplinary courses that reach beyond the classroom and connect with society and business, as well as with other research disciplines and professions. The intent is to bring individual students together into "academic maker communities" through engaging them in design work focused on creating creative and thoughtful ideation, collaboration for solving problems, and experience with new skills such as coding, digital fabrication, and product development. Makerspaces, hackatons and game jams are viewed as being more "democratic," "inclusive," and "agenda-less" sites where students across disciplines can work side-by-side on idea-generation, problem-solving, and prototyping solutions – and where academics have the ability to share their knowledge and technological expertise with others (Ames, et al., 2014; Dellot, 2015).

Academic game jams as design research

Although research on design spaces and processes has a noteworthy history at certain institutions (e.g. Cutkosky & Tenenbaum 1990), such studies are relatively new to many universities. In particular, relatively little research exists in higher education on *what*

makerspaces and game jams are, *how* they are most meaningfully and best pedagogically carried out, and *why* they might be valuable contributors to the academy.

Most discussions about university game jams focus on the kinds of activities involved like coding and constructing a game product, as well as the experience being fun and motivating. Notably lacking from studies on game jams is attention to the kind of pedagogy and process that scaffold valuable academic learning, as well as the development of professional competencies. Often, game jams are not integral part of curriculum or courses; instead, they function as motivating extra-curricular activities, or are organized as social activities bringing students together to have fun. Frequently, individuals simply sign up and drop in to hang out and jam together with other interested students. Furthermore, knowledge is also lacking in regards to how academic game jams might connect to the larger framework of education within which they are embedded. While design processes and games might be an integral part of some students' coursework, game jams generally function as a detached addendum or purely practical dimension of the curriculum. Game jams are not framed as potential provider of academic knowledge, prospective professional competencies or thoughtful entrepreneurial agency.

However, what constitutes game jams is the requirement to be able to externalize one's thinking into an object that expresses that thinking, and then to present and argue for the ingenuity and thoroughness of that thinking. In that way, academic game jams aim towards the production of thoughtful objects or objects to think with in the form of interactive prototypes (Mor, 2013). Academic game jams stand out as thoughtful interaction design (Löwgren & Stolterman, 2004), where the students enter into a reflective conversation with the materials at hand (Bamberger & Schön, 1983). In this context, they tackle ill-structured wicked problems (Buchanan, 1992) in an effort to externalise their design ideas through making prototypes which serve as manifestations of their understanding (Lim, Stolterman & Tenenberg, 2008). Consequently, academic game jams can be thought of as *gameful design based research*.

Such a gameful design-based research process is the act of moving between game ideas and the game design situation in the form of a conversation between the situation at hand and the designer. An academic game jam is then carried out through a dialogue between the designer's academic research and critical reflection on the one hand and the designer's gameful ideation and design process on the other. The process uses a sequence of rule modifications and updating behaviors of game components – an iterative playtest,-evaluate-modify cycle of design. "It is through iteration that game designers achieve the right balance between challenge, choice, and fun." (Salen, 2007, s. 318).

When game jams take up a research-through-design approach, game design is transformed and performed as research through the act of designing where academic knowledge becomes embedded in a final product or a process (Frayling, 1993, p. 5).

Thus, research through design is a method for exploring a subject (e.g. motivation, immersion, violence, or archeology) in interaction through a design process. The subject area (e.g. archeology) then becomes a source domain researched through the process of a game jam aimed at a target domain (a game in the form of an academic argument for the subject area). Such design-based research processes can be described as:

> "…an ongoing process of innovation. The research process is therefore stimulated by the intended improvement in the design. In comparison to traditional research design and pure evaluation, design based research is characterized by the following specific benefits: – innovation is at the cutting edge of theoretical knowledge – the implementation will be accompanied by the research team – stakeholders in the field are not only «data providers», but also actively customize the design – effects are continuously analysed with quantitative and qualitative methods which allows for the prompt adjustments to the implementation – The concept itself and the theoretical foundations are continuously reviewed and adapted." (Frafel 2014)

He visualizes this process of ongoing evaluation in the below model that can also serve as a model for the development of games through academic game jams:

Figure 1: Design based research as an ongoing process of innovation
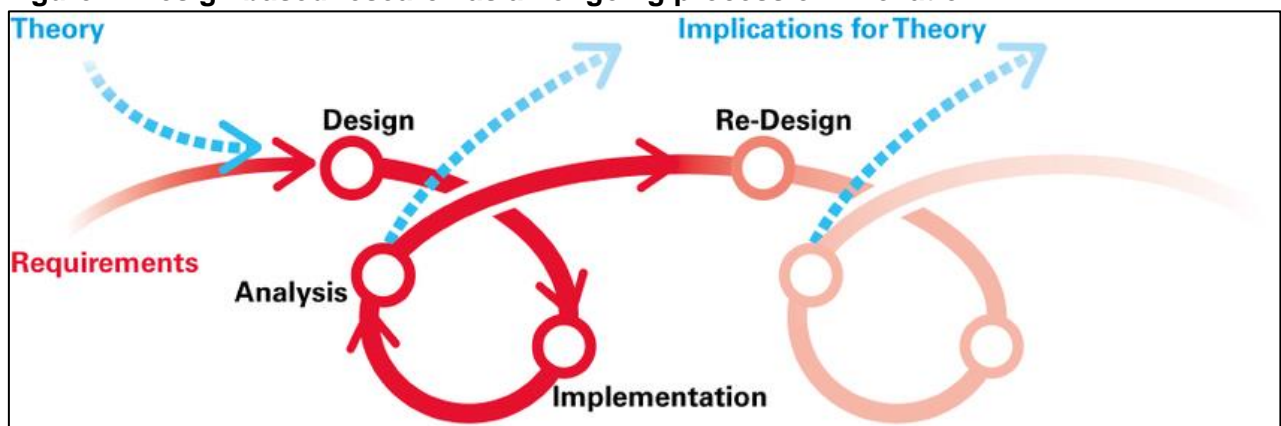
Source: Frafel 2014

While we are enthusiastic about the potential for new kinds of academic knowing, the potency of developing entrepreneurial spirit in students and promoting competencies in thoughtful interaction design and reflective design processes in higher education, we are moved to ask: What kind of pedagogy is necessary to promote academic game jams through design thinking? How might universities take advantage of the productive use of academic game jams to foster participation in education through interdisciplinarity, collaboration, and critical problem-solving?

Fundamentally, we contend that simply being exposed to game jams or doing game jams as add-on or extra-curricular activity might not be sufficient to propel students into a reflective entrepreneurial mindset or proactive prospective academic practice beyond the institution (Anderson, 2012). Our purpose here is to provide a framework for reflective game jam pedagogy in higher education. We argue that becoming proficient in reflective

design practice (Schön, 1984; Nelson & Stolerman, 2012) is vital for game jams to realize their learning potential. Toward this goal, game jams require teachers to facilitate learning processes that contrast fundamentally from the didactic instruction of a lecture, or even laboratory-based instruction (Brandt et al., 2013). Developing academic knowledge through design based research in the form of game jams is not a straight-forward process; it requires pedagogical proficiency in facilitating iterative open-ended processes, promoting convergent and divergent thinking, academic inquiry with materials, and an ability for pedagogical flexibility and improvisation (Nørgård & Paaskesen, 2016; Nørgård & Brandt, 2016; Bamberger & Schön, 1983; Lampert, 2006; Sheridan, et al., 2014).

In the following sections, we identify the key structures and practices that characterize a collaborative studio environment. Specifically, we outline a 'signature pedagogy' (Shulman, 2005a; Shulman 2005b; Horn, 2013) of design thinking that forms the foundation of a making culture in makerspaces. We discuss ways to bring critical pedagogy and perspective taking to foster the development of maker culture citizenship that addresses problems relevant to the communities in which we are situated. This critical, reflective approach integrates the arts and humanities as part of the design process as means to better understand social problems and environmental sustainability. Finally, we outline a strategy for developing and refining a jam-centric curriculum.

A signature pedagogy for academic game jams

People trying out game jams often have backgrounds in technology education, computing, or science education with potentially little or no prior experience with design processes or design thinking. Being technologically literate and skilled in coding or engineering doesn't necessarily qualify a person to be a teacher in academic game jams. We argue for teaching support and development in game jams that exhibit an explicit emphasis on fostering and promoting 'educational design thinking' (Nørgård, 2015; Nørgård & Paaskesen, 2016). We highlight elements of this "signature pedagogy" for academic game jams, that is, pedagogical practices that travel across academic game jam design processes.

Lee Shulman defines signature pedagogies as "the types of teaching that organize the fundamental ways in which future practitioners are educated for their new professions" (Shulman, 2005a, p. 52). For Shulman, a signature pedagogy has three dimensions: surface structure, deep structure, and an implicit structure that come together in different ways to configure how different professions think, perform and act with integrity. Through these structures practitioners are educated to perform like a physician, think like a lawyer, or act like a nurse (p. 52). As such, signature pedagogies prepare practitioners for 'professional academic work' (p. 54). Surface structures consist of concrete, visible acts of teaching and learning, while deep structures reflect a set of assumptions about how best to impart a certain body of knowledge and know-how within a certain domain or activity. The implicit structure includes a moral dimension that comprises a set of habits

and beliefs about professional attitudes, values, and dispositions (pp. 54-55). Signature pedagogies comprise the stable academic framework within which teachers and students can be experimenting and creative when practicing game jams. In this way, signature pedagogy constitutes a conversation between academic novelty and norms. Habits of the mind, heart, and hand that are expressed in the game jam through its particular signature pedagogy making the students not think with their mind, heart, and mind but through them (p. 56). Figure 2 summarizes the use of signature pedagogy as the framework for developing academic game jams in higher education.

Figure 2: Signature pedagogy in the context of game jams in higher education
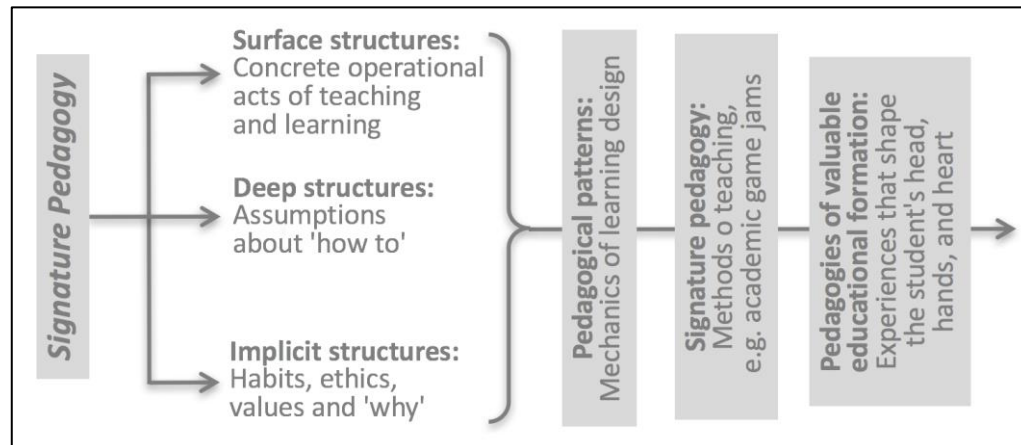
Source: Aarhus University, based on Shulman 2005

Adapting the lens of signature pedagogy when thinking about teaching and learning through game jams provides a shift in focus from the fun of games, new technologies, coding skills and end products towards student academic performance of roles (hands, head and heart) through reflective game-making in game jams: "This emphasis on students' active performance reduces the most significant impediments to learning in higher education: passivity, invisibility, anonymity, and lack of accountability" (p. 57).

Overall, signature pedagogies are 'pedagogies of uncertainty' (p. 57), aligning well with the aim of design thinking that by Nelson & Stolterman (2012) has been defined as creating intentional change in an unpredictable world through the ability to make reflective judgments under uncertainty. Furthermore, powerful signature pedagogies are the ones that are able to teach through balancing hands, head, and heart in ways that does not subordinate one to the others as we often see in the present practice of game jams as fun activities carried out through coding (hands) or academic knowledge as solely taking place in the head (Shulman, 2005b).

Surface structures of academic game jams

The surface structures are the concrete operational acts of teaching and learning in the game jams – that is, what is visible on the surface of game jams in action. It is also often the things we will initially explain when trying to describe what game jams are. The

surface level is, among other things, constituted by the technologies, code, sketches, prototypes, people in the room, furniture, pencils, paper and so on. In academic game jams, the surface level is made up of the participants' inquiries into the ill-structured wicked design problem visible as a series of design investigations. These investigations can be undertaken through quick sketches, scenarios, mock-ups, design briefs, inspiration materials, visual artwork and other 'objects to think with and talk about' (Mor, 2013). The surface level is the visible sign of (or lack of) a thoughtful interaction design process occurring in the form of critical reflective game-making. As such, the materials on the surface level constitute an inquiry into a problem field, an investigation of the wicked problems inhabiting that field, and the back-and-forth reflection in action through critical conversation with the material at hand.

Deep structures of academic game jams

Deep structures are the assumptions about how best to impart knowledge through teaching the heads, hearts and hands of the students. The deep structures are the pedagogical practice of the teacher in relation to how to do academic game jams. How are the processes to be structured so as to best impart the academic knowledge, entrepreneurial spirit and design practice that the particular game jam aims for? It is in the deep structures that the materials of the surface level come together and become dynamic. It is the pedagogical performance engraved in academic game jams whether the aim is to develop engineering skills, archeological knowledge, innovative game ideas or foster risk-taking and open experiments in STEM education. Shulman (2005a) points to deep structure as an important element of signature pedagogy in which the teacher imparts how knowledge is constructed within a profession through the dynamic enactment of surface structures. In academic game jams, the construction of critical reflection, collaboration, creative risk-taking and prospective orientation through making design decisions are the keys to success.

Figure 3: The design space that students, teachers, and researchers move through during the game jam process
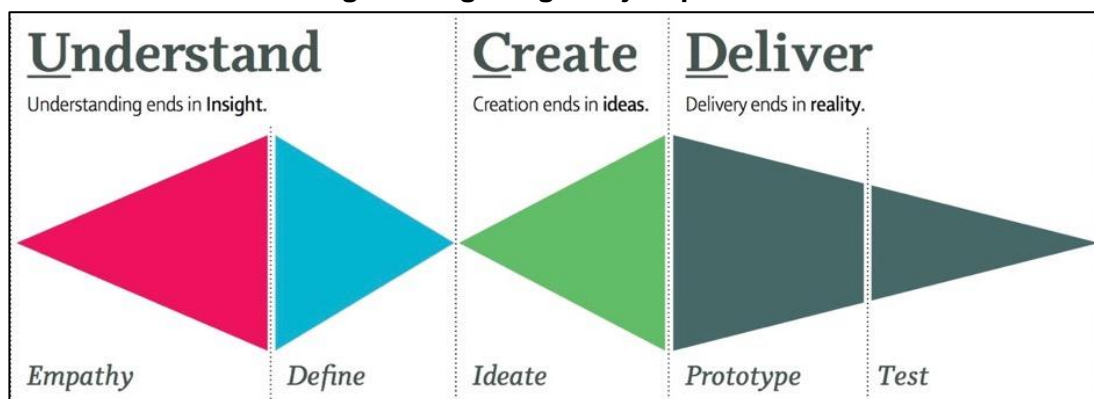
Source: designthinking.co.nz/design-thinking-for-government

Deep structures in game jams are communicated in the form of a design process, as shown in Figure 3. First, the pedagogical stance is one of inviting the students to gain insight into a specific game jam domain through exploring it empathetically. Next, students develop an understanding of the game jam domain through defining the problem and solution space by way of making sketches, scenarios, developing the design brief and game design specifications. Thirdly, the defined game jam space is explored through creating multiple mock ups and low-fidelity prototypes that materializes the game jam idea in order to establish its thoughtfulness, criticality and level of academic reflection.

Often the ideation phase develops into a more substantial prototype phase where a specific prototype is developed through design crits (i.e. 'critiques') where students and teachers meet to discuss the viability of the prototype and the strength of the design concept. In a crit, peer input and questioning require the gamemaker to justify their design decisions. The gamemakers are challenged to develop their academic reasoning and substantiate their claims in relation to their game concept. This process is facilitated by the teacher and often takes a Socratic approach to questioning in which complex ideas are examined. The students might go through several rounds of crits and design revisions and reasoning before constructing their final game design. Finally, the game design concept is materialized into a functional game that can be played and tested by players as the outcome of the academic game jam, thus, in effect functioning as a proof of concept in relation to the specific academic domain the game jam engaged and explored.

Implicit structures of academic game jams

Implicit structures are the so-called 'hidden curriculum' that includes the underlying pedagogical values and reasoning for practicing academic game jams. These elements of pedagogy reflect the attitudes beliefs, and approaches of a certain profession such as engineering or archeology (horizontal signature pedagogy) or a certain format such as multiple choice quizzes or game jams (vertical signature pedagogy). The implicit structures shape the experience and interaction of the students through the way they are invited to think, act and feel when engaged with an educational activity such as academic game jams.

Such activities can be the site of innovation and entrepreneurship, but we ask, can we direct this entrepreneurial spirit to be more thoughtful, inquiry-based, and a part of a critical reflective professional practice? Can game jams be configured in higher education through signature pedagogy to foster and promote academic practices and citizenship that work to integrate people, society and university into each other (Nørgård & Bengtsen, 2016)? Can the promotion of critical reflective game jams support this integration in ways that inspire students to address the "wicked problems" (Buchanan, 1992) that characterize our modern world (e.g., energy sustainability, access to food and water, affordable housing, and distribution of adequate healthcare) through game-making? Can

game jams in higher education be deemed successful if they only result in shiny new games that are fun to make and fun to play? Might there be more thoughtful and deeper potentials of academic game jams nested within the hidden curriculum of 'good education'?

One concern is that game jams may be seen as academically inauthentic, irresponsible, and isolated activities that are detached from any practiced pedagogy (deep structure) and deeper meaning of education (hidden curriculum). They are seen, in effect, a surface activity containing nothing more than superficial learning. We try to address this by creating a jam-centric curriculum aimed at academic knowing, doing and being that is both reflective and critical as well as proactive and prospective. We now describe the results of adopting such a pedagogical stance.

Signature pedagogy of academic game jams

Signature pedagogy in the design studio forces us to consider the values and visions that are integral to our practice and field as well as how our curriculum reflects and supports this. Furthermore, signature pedagogy highlights students as reflective and proactive agents in game jams – through game jams, they reflect their academic knowledge through producing games that functions as expressions of educated heads, hearts, and hands. As such we need to reflectively and critically explore and experiment with different stances, approaches, perspectives, and values in relation to game jams in order to improve the level of academic citizenship and professional expertise that we promote through the dialogues, co-creations, and orchestrations we enter into as teachers with our students in the academic game jam. One might therefore say that 'designing for' the educational formation of students through academic game jams and the creation of jam-centric curriculums is about developing game jam pedagogies that link academic knowledge, entrepreneurial spirit, and design practice under conditions of inherent uncertainty through design processes, prototypes, design crits and game-making as prospective future-making.

We value the opportunity for an open and flexible learning environment at the university, such as is found in game jams where faculty and students have access to new forms of technology and where they can learn new skills in game-making. However, in the present paper we argue that instead of simply being fun drop-in activities that universities take up to engage students through creating games, academic game jams have the potential of becoming open-ended flexible mediators between reflection and intuition, rationality and passion, intentionality and improvisation, individuality and collectivity, thinking and tinkering, academic citizenship and professional practice through the ways it integrates surface structures, deep structures, and implicit structures. Signature pedagogy counters the superficial practice of game jams through putting what Shulman (2005b) calls 'accountable talk' – the critical dialogues and reflective co-creations in the center of teaching – and 'presence of emotion' – the rewarding academic experiences and

valuable professional practice driving the heart of the academic game jam. This integration gives new meaning to game jams that changes them from being shiny fun activities to critical academic activities for 'pedagogies of formation' (Shulman 2005a).

Jam-Centric Curriculum Design

We now discuss an innovative approach to curriculum design for practical multi-disciplinary game development programs. Specifically, we propose to undertake qualitative and quantitative research on teams of participants in popular game development events, such as Global Game Jam (GGJ). This work involves examining their background demographics, and characterizing the team dynamics and behaviors in the context of their game design and development activities during the game jam. We then move to an exploration of the results of their work during the jam – the prototype games that were produced, the corresponding repositories of source code and art assets, etc. The outcomes of these integrated multimodal analyses are used to inspire and tailor the andragogical approach of a jam-focused game development curriculum, as shown in Figure 4.

Figure 4: Longitudinal study to support jam-centric curriculum development
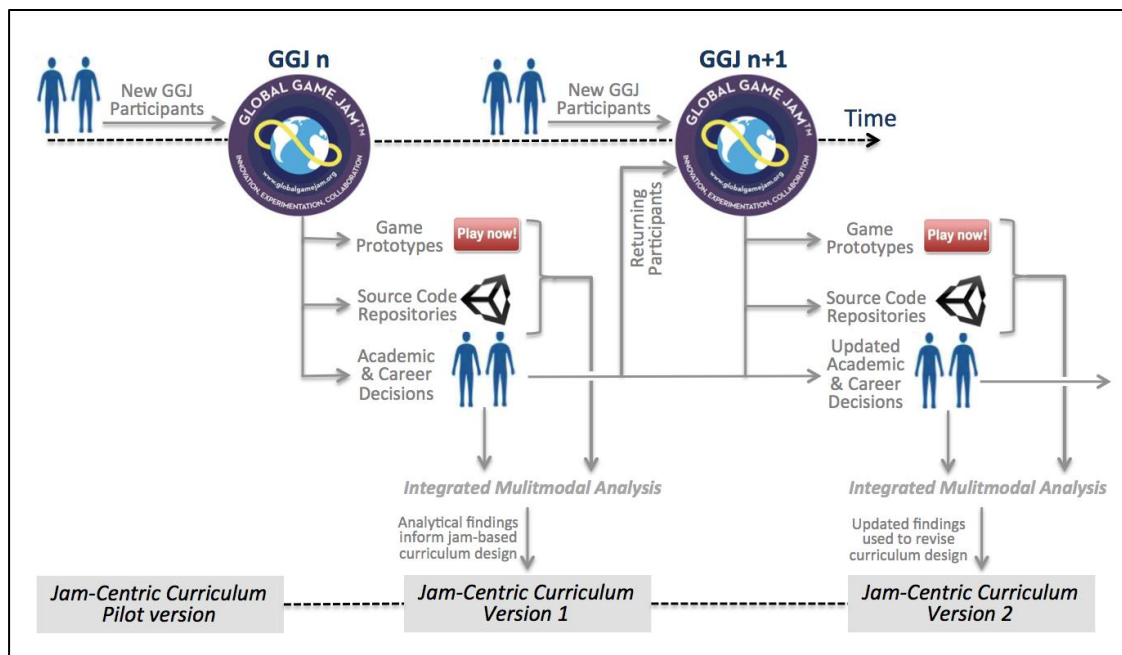
Source: San José State University

We anticipate that a set of regularly-scheduled game jams, undertaken during a single course within a broader curriculum, would form an optional part of a cross-listed and interdisciplinary game studies program, primarily (thought not exclusively) aimed at the undergraduate level. We see the overall educational design process as a longitudinal study iterating annually, with the results from a sequence of GGJ events being used to update, adapt, and evolve the jam-centric curriculum in each successive academic year.

Opportunities for Diversity Studies

Within the game studies community, there has been increasing attention to using game jams as opportunities to undertake research into student diversity issues and outreach to underserved groups (e.g. Fowler & Schreiber, 2017; Jakobsson et al, 2017). In some cases, this work may concern smoothing access for underserved students to academic STEM subjects in general. However, an important aspect of diversity research in the specific context of the jam is examining individual roles and behaviors of the participants during their actual design and development activities. The demographic differences in the student populations at our respective institutions provide us with rich multi-cultural research resources extending well beyond the reach of traditional design studies endeavors.

Curriculum Structure

Table 1 summarizes the structure of a four-week design and development sprint cycle that incorporates an eight-hour jam event. This curriculum module is run up to 3 times in a 15 week semester and can support technological adaptations (Gamemaker, Oculus, Unity, mobile, board games, city games, ARG etc) in each cycle. Also, content- or subject-specific aspects of games can be accommodated, such as Engineering Simulations, Cybersecurity Awareness, Educational Assessment Games, etc.

Key Research Questions

What are the characteristics of a GGJ site that result in multiple successful games? Can these features be grouped and made part of the four-week curriculum and game jam cycle?

What are the differences in team size, technical background, and site support? How do these features affect game production?

Table 1: Four-week jam-centric design sprint cycle

Week 1: *Background and Introduction*	Design Theory Technical Demos: Tools for artists and programmers Content lecture: Prototyping
Week 2: *Tutorial and Workshop*	Content lecture: Development roles, pipeline, process, repository
Week 3: *Skill Development and Game Jam*	Content lecture: Prototyping, technical skill building Eight-hour Jam
Week 4: *Wrap up and Reflection*	Decompression and reflection on the process Archiving/shipping games

Source: San José State University

Next Steps: Some Suggestions

One early approach to the analytics element of this research may be to focus initially upon a subsection of GGJ games, such as the 938 games that use standard web-based technologies. This would enable the possibility of crowd-sourcing the game assessment

task using a simple classification rubric for evaluation, perhaps one that characterizes game mechanics, visual aesthetics and fun-ness. At the same time, we retrieve and structure the public information about the GGJ teams that made these web games, as well as applying automated evaluation tools to the published source code. One tentative plan is to run two or pilot tests of the four- week sprint cycle during the fall semester (Sept-Dec). From this experience, we would expect to use the lessons learned to inform the organization and structure of the subsequent GGJ event, which is held annually in later January at multiple institutions. For example, a timely completion of the initial data analysis may enable us to propose additional data that could be gathered by the website platforms. We would also undertake follow-up interviews with Global Game Jam participants, to obtain further insights on their subsequent academic tracks, and career decisions as they moved out of the university sphere.

Conclusions

In this paper, we have discussed the study of academic game jams and similar creative events in the context of design research. Although traditional design spaces and processes have long been objects of study in some institutions, relatively little research exists specifically on the use of game jams and other events in higher education. We described signature pedagogies and the associated structures, which offer a means to frame the implementation and practice within the educational environment. We then follow up with an approach to using a set of regularly-scheduled short game jams, which could be undertaken during a one-semester course within a broader curriculum.

Acknowledgements

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