TOG: An Innovation Centric Approach to teaching Computational Expression and Game Design

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ABSTRACT

This paper describes the design approach TOG (standing for Technology, Ontology, and Game Genre), and how it can be used in teaching game design and technologies enabling computational expression. TOG, inspired by the processes of AI Based Game Design, was conceptualized when teaching a course on computational expression at the University of Malta. The main aim with teaching with the approach was to facilitate innovation and to prompt students to expand their palette of methods for computational expression as game designers.

Keywords

pedagogy, game design, teaching, AI-based Game design, case study, computational expression

INTRODUCTION

A basic goal of game design pedagogy is the *techno-aesthetic minimum* which I mean that a) engineers need to have sufficient consideration for aesthetic and experiential aspects in order to create a satisfying player experience, and b) that artists need to have sufficient technological proficiency to have a palette of options to work with. Consequently, any educator originating in the humanistic or social sciences would be severely handicapped by not understanding the technologies underlying computational expression, while computer scientist and engineers would be hampered without an appreciation of aesthetic categories. Together, they need to develop an understanding of the expressive opportunities afforded by the combination of technology and art. It is a fundamental challenge of game design teaching to bring about the "techno-aesthetic minimum" as a foundation for more advanced skills. In this paper, the game design approach TOG (Technology, Ontology, and Game Genre) is described, along with a case study from a course that uses TOG in teaching. The process of using the TOG approach was designed to create the fundamental understanding of a techno-aesthetic minimum in game design students. Another, equally important aim with the TOG approach is to foster innovation. The TOG triad may sparkle new unexpected ideas and needs coming from the unique combinations of what technology, ontology, and game genre that serves as starting points for the design.

In order to illustrate how the TOG approach can be used in teaching, a case study is presented from a course of 5 ETCS credits which was taught at masters' level. The case presented is

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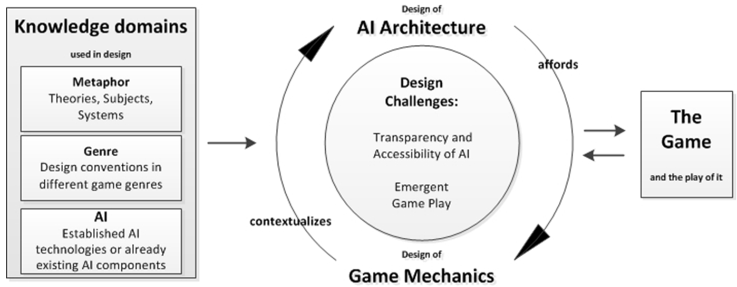

Figure 1: The process of designing AI-Based games.

of particular interest to educators who are teaching students who have mixed educational backgrounds, where this approach can help student groups to work in ways where they can both harness their existing knowledge and gain new means of expression together with their peers. It is also useful for those who teaches groups that have more homogeneous educational backgrounds - the TOG triad has been useful in order to help students expand their palette of expression in game design.

Students participating in the course have reported it as inspiring, stating that it has helped expanding their horizon, and having made things they did not expect to. After the course a many of the students participating later based their dissertation works on the design experiments and prototypes they made during the course.

The TOG approach has grown informed by work reflecting on processes for AI Based Game Design (AIGD). In this context it is crucial to recognize that game creation is, even when taught within the engineering disciplines, fundamentally a liberal art. Game creators build worlds and formulate ontologies, reading up on plethora of subjects for inspiration - biology, art, music, psychology, economics, politics, learning sciences, architecture, and more. Given the nature of games - as pieces made for audiences - we need to consider that they have different evaluation criteria than those of traditional engineering disciplines. Horswill et al (Horswill et al. 2019) argues,"the evaluation criteria of computational media are ultimately aesthetic: the value of a piece lies in its ability to engage its audience, and the value of a technology lies in its ability to allow artists and designers to develop engaging pieces." Yet even without these overarching perspectives, we can see that the broadness and openness of systematic perspectives and combinatorics at the heart of game design give rise to a rich design space, full of opportunities. The TOG approach is intended to prepare and enable students for the richness of computational media, or as Bolter (Bolter 2019) recently expressed it, this "digital plenitude".

BACKGROUND

The TOG triad of Technology, Ontology, and Game Genre builds upon previous work of doing cases studies for the process of AI-Based Game Design (AIGD) (Eladhari et al. 2011). The notion of AI based games means that game mechanics are intertwined with the AI systems used to realise the game.

When examining our work processes in making AI based games, we (Eladhari et al. 2011) found that a common denominator in our practice was to to use knowledge domains in triples in the design process, e.g.

1. a main metaphor, based on a subject area or theory,
2. an AI technology, and
3. game genre convention(s).

For example, a game basing its core game play on musical theory invites different types of play activities in comparison to a game based on collaborative storytelling. Design conventions, such as the typical challenges that players face in real-time strategy games, computer role-playing games, or first-person shooters shape what affordances designers create for players within the systems. Conventions connected to often-used AI methods can both constrain and open up a design space. To use another example, adopting a belief-desire-intention architectural approach (Rao and Georgeff 1995) for autonomous entities in a game would imply that autonomous entities should be able to perceive a world, believe something about it, desire something, and have means to satisfy that desire.

As we (Eladhari et al. 2011) found this triadic approach of AIGD useful for explorative research in AI Based games, it seemed like a promising way to teach methods for computational expression in connection to game design at post graduate level. It also seemed like a potentially promising avenue towards facilitating innovation in educational settings, both in game design, and in computational methods, spurred by problems that might not have arisen otherwise.

CASE STUDY

The course ”Computational Expression” of 5 ETCS was designed at the University of Malta and was offered for two consecutive years (after which the author moved). In the first year the course was focused entirely on AIGD. The AIGD design process was explained to students by using the illustration in Figure 1. The second time, the approach was broadened, allowing students to base their designs on any significant technology of their choosing. That is, the technology did not have to be an AI approach, but instead could apply new tools for interaction, for example bio-feedback sensors and virtual reality goggles.

The courses were taught at masters level in 2013 and 2014. The majority of students had their main educational background in computing, which helped lower the threshold for using the technological approaches involved. However, students with other backgrounds were accommodated with development tools that did not require prior programming knowledge, but that still provided hands-on experience in using AI approaches, authoring systems and different types of input and display systems. In 2013, when the educational program was new, five students participated in the unit, which then was part of a course named Game Design III. In 2014 11 students took the course.

The course was structured into the following work phases:

1. Knowledge gathering,

2. Conceptualization,
3. Development and play testing,
4. Reflection: Presentation, feedback, and write-up.

In the following, the work conducted in these phases is described.

Knowledge gathering phase

The Knowledge Gathering Phase was dedicated to giving students an idea about the possibilities of AI techniques commonly used in games by means of seminars followed by hands-on practice in workshops, allowing students to expand their creative 'palette' as designers. The seminars were focused on different themes, including AI-Based Games, Software studies, Interactive Narrative, Characterisation and Agents, Procedurally Generated Content, Computational Creativity, and Artificial Life. In the workshops students got to work with a range of technologies related to the seminar themes, as well as input devices, including Occulus Rift, and various bio data gathering devices.

In the first seminar students chose themes, texts and tools, which they later presented to their peers. Doing so, they became the group's experts on different approaches, championing their chosen themes. Most of the learning was done by reading and by trying on technologies hands on, but in addition experts in the subjects were invited to give guest lectures via teleconferencing. The motivation was to give the students examples of work illustrating what can be accomplished with different approaches.[1]

Conceptualization Phase

In the Conceptualization Phase, students worked in groups, brainstorming and creating prototypes. Their first task was to narrow down what they wanted to make; what type of game, what type of technology to have at its core, and what subject area or theory to use as the main metaphor in the design (the ontology). Early on, group members needed to agree on design goals in terms of player experience. The following questions were used as guidance:

1. What are the underlying theories or subject areas used as metaphors for the design of the game?
2. What, if any, game genre conventions are used?
3. What technologies, AI systems, or tools are used, and how could they affect the design of the game world and the game mechanics?

Development and Play Testing Phase

In the Development and Play-testing Phase students created digital playable games. For the play-testing, students were asked to consider whether the impact of certain domains, or ontologies, affect the game in a way that is appropriate according to the design goals, and if not, to make necessary changes. In play testing students payed special attention to the following questions:

1. Do the metaphors used in the design match players' mental models of them?
2. Are the workings of the underlying computational systems transparent to the players?
3. Do players assign intentionality to computational processes in the game world?

If players assigned intentionality it was regarded as positive, because it can mean that players are suspending their disbelief in terms of immersion into the system. The questions above were inspired by from previous work on AIGD (Eladhari et al. 2011) where these aspects were found to be of special concern for creating emergent systems that accommodate input from users.

Reflection Phase: Presentation, Feedback and Write-up

In the Reflection Phase students finalized their games and showed them in the seminar. We reflected on the design process, and discussed promising aspects. Finally students authored their reports, reasoning about how the TOG Triad affected their design processes.

After the courses

After the course, students reflected on their learning process. They each answered a survey, each wrote an individual piece as part of their assignments, and participated in a discussion in the last seminar. A common element in students' reflections after the course was that they found the approach useful for ideation. They also appreciated the resulting non-standard and innovative projects. Regarding learning new technological approaches, students appreciated the structure where they each were able to champion one or several approaches in seminars, this leading to a seminar-group where they could turn to each others as 'experts'. As a side note; during conversations, we referred to our common knowledge as our "hive-mind" that was developed in the seminar context, knowing who was diving deeper into respective subjects in order to bring more insight and skill to the hive. Commonly, students individually focused on those approaches they wanted to use or develop in their future careers. Hands-on experience in using different tools and technological approaches in the workshops was mentioned as a positive aspect which was also described as improving the confidence in using them in the future. For the development process, many noted that focusing on one specific technology or AI method along with their game design helped making it feasible to produce a playable prototype within the given time frame.

Evaluation of the materials produced during course indicated that the student groups who had put strong effort into studying and integrating their metaphoric ontology into the game and technology design produced the more interesting projects. The criteria used for this evaluation was the play-test the students conducted during the course. These indicated that those designs which were based on ontologies were considered more interesting by the study participants. A selection of illustration documenting the work in the course in the form of photos, screen-shots and videos is available see (Eladhari 2015). The participation and level of engagement in the course was exceptional: In both iterations of the course the all the students returned all their deliverables on time, and according to instruction. Two years after the first course on computational expression, almost half of the students based their exam projects on ideas developed during this particular course.

USING TOG IN TEACHING

Depending on the technologies used, the TOG approach can be modified according to the needs and technological proficiency of the students, and to the learning goals set by the educators. Students with computing science backgrounds can reflect deeper on aesthetic aspects in the use of technology. Students with artistic, humanistic or social science background can apply prior knowledge when getting hands-on experience in using various computational methods. Hence, using the TOG design approach teaching can make inroads towards a techno-aesthetic minimum for groups of students, increasing their common understanding of the expressive opportunities afforded by the combination of technology and game design. The use of ontologies in the design appears, informed by the case study presented above, to be key, facilitating a connection to real-life systems and inviting adaptation of such for concrete game designs.

It is important to point out that the TOG triad is only the starting point of the design process: once the work is started, the parts of the triads feed into each other. It appears that the approach can be of particular use for fostering innovation, at multiple levels: a technology may not be able to cater to the design: hence an existing computational method needs to be improved, modified or invented. A particular design may not fall into any category, or 'given' game design conventions may not cater to them either: hence innovative game play is created.

SUMMARY

Using the TOG (Technology, Ontology, and Genre) approach in teaching game creation allows students to reflect on genre conventions and learn about particular technologies. In addition, it facilitates a connection to real-life system and invites adaptation of such for concrete game designs. A case study based on teaching a course on computational expression of 5 ETCS in two consecutive years at University of Malta indicated that the approach is promising, allowing students to add different technological approaches to their artistic palettes as game developers and to create non-standard prototypes.

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END NOTES

1. In the course given in 2014 four guests were invited. Brian Magerko described ongoing work with Viewpoints AI (Jacob and Magerko 2015), Gillian Smith presented her work on Tanagra (Smith et al. 2010), and Richard Evans expanded upon his work with building a a world of rules via the Praxis language he designed for the engine Versu. Evans also answered students' questions about the development of the AI for the creatures in the game Black and White (Electronic Arts 2001) whose behavior is determined by the players' actions, and about the AI for Sims 3 (The Sims Studio 2009) of which he was the AI lead. A central text in the course literature was (Wardrip-Fruin 2009) as it describes the experiential and aesthetic effects of using computational expression, and in one of the seminars Noah Wardrip-Fruin gave a lecture and discussed the topic (especially the Sim City Effect) with the group.

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