

Kuxtal: Student Motivation Through Megagames in Higher Education Design Students

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Abstract: Megagames are an engaging combination of different game resources. They involve role-play, social connection, simulations, rules, economics, politics, decision making among others that are merged into an immersive narrative, all of which are essential applications of experiential learning. They can last from one day up to one month, they are known to be collaborative and can be played by several players at the same time. In education, collaboration between individuals is an integral competence that has to be nurtured among the academic community. During the game dynamics, multiple experiences, events, and actions are activated that enhance curiosity and emotions among students which, in turn, impact their motivation in the learning process. Wicked problems are undetermined problems that are resistant to change, possess a social and cultural context, several stakeholders are involved and overall are complex to solve. In this paper we explore 1) the use of megagames as a component to motivate student-learning of Higher Education (HE) students of the fourth semester of a degree in Design at the Tecnológico de Monterrey institution, located in the northwestern region of Mexico in the State of Sonora. We also 2) analyzed if research and action was triggered among students through the megagame, Kuxtal. The megagame, aims to promote student-learning through understanding wicked problems: that all living beings face in regards to water: its scarcity, its pollution and its mismanagement. In this qualitative study, we used Jones (2021) user guide for assessing components of the MUSIC model of motivation to understand empowerment, usefulness, success, interest, and caring. With the incorporation of megagames in the classroom, educators were able to promote student motivation and students engaged in research methodology, all while adopting small world-changing actions in their everyday lives. This paper aims to promote the advantages of using megagames as an educational resource in Higher Education creative fields such as Design, Architecture and Communication.

Keywords: Experiential learning, Higher education, Educational innovation, Megagames, Tec 21 educative model

1. Introduction

In order to achieve expected learning outcomes in Higher Education (HE) students in a Design major, the planning, the execution and the design itself of the course must not only be adequate for the intended targeted goals, but it must also be attractive for them. Added to the learning outcome, the incorporation of real-life problems that students can relate with can motivate them to become active participants in the solution to such regional, national or world problems today.

Nowadays, Higher Education institutions understand the importance of funding research and innovation projects by providing resources, infrastructure and tools to enhance Research and Development (R&D) efforts in order to participate in the global research community and contribute knowledge for a better society. With this said, research methodology is not known to be highly promoted in undergraduate courses for several reasons. According to Evans (2010), this is due to HE professors themselves having to produce research in tight turn-around times, conduct research projects and compete for grants while having to guide graduate students and carry out teaching activities all at once.

The active participation of undergraduate students in research activities can provide them with useful long-term skills that can be applied in their field of choice (whether it be in a professional setting) or in future graduate studies. Such added skills can range from lab techniques, theory analysis and comprehension, data analysis, project proposal development, independent and team work skills, to name a few (Petrella, 2008). As in all research, funding R&D projects at a HE level (be that in graduate or undergraduate programs) continues to be a source of conditions that restrain or push the work of the scientific community (Petrella, 2008).

2. Context

In Mexico, the situation of research and development becomes even more complex due to the nature of research practice in the country. The scientific community is constantly in a competition for the limited resources available to them for R&D projects through federal, state or private grants. The National Council for Science and Technology (*Conacyt* for its acronym in Spanish) is the leading provider of funding for HE institutions in the

country, being the Universidad Nacional Autónoma de México (UNAM) the nation's top research production university.

While research and development is not necessarily highly promoted in undergraduate studies, the need to do so is important to foster and cultivate a sense of curiosity towards research production in any field. In the case of the Arts, scientific production does.

With this said, the need for more promotion from professors, the limited funding for undergraduate research and the low motivation for research methodology among HE students in a Design course provided us with our driving question: How can we develop student-motivation among them for research methodology and motivate them in their learning process? and how can we motivate them to develop possible solutions for 'wicked problems' in their communities?

2.1 Student Motivation in Higher Education

Seifert (2004) notes that, in order to achieve student motivation in classrooms at any academic level, they must be provided with environments that invite creativity, a sense of autonomy, inclusion and education that lets students actively participate in the design of the learning process.

The task of increasing student motivation is often left to educators, which can lead students to be passive actors in the learning process. However, the willingness to learn, be curious and actively engage in the learning process must also come from within the students themselves (intrinsic motivation) (Williams-Pierce, 2011). According to Williams-Pierce (2011), the 'formula' to achieve student motivation at any level is non-existent, but some factors can come up as useful to do so. She notes that there are five 'ingredientes': 1) students must be willing to learn; 2) professors also have to provide proper rapport and guidance to students; 3) the content to teach must attract students interests 4) presented in a way that can be attractive to learners, all while 5) maintaining a welcoming and creative environment that promotes innovation among students and professors alike.

At a Higher Education (HE) level, student motivation can be achieved and retained. This is a pressing matter that schools should have as priority. Rizkallah and Seitz (2017) point out that there are stages in a student's journey through their studies, where institutions need to pay close attention to achieve their targets. Such stages for the authors are the following: discovery, establishment, engagement and future-driven stage. In all of them, the authors note that there must be proper guidance by faculty to enhance retention numbers.

At a classroom level, student motivation is more complex. Liu, Bridgeman and Adler (2012) mentioned that "college learning outcomes are much broader than what's captured by learning outcomes assessments. College learning covers learning in disciplinary subjects" (p. 360). However, the authors observed that, as expected, students that have more motivation can be able to increase their evaluation scores and their knowledge acquisition. When dealing with HE students, educators need to value opinions, inputs and student creativity. While acknowledging so, they can develop a motivation towards the expected outcome they face. And, by including games (in our study megagames) to the equation, it can be a useful resource.

2.2 Megagames in Higher Education

As humans, playing is an essential part of us. Playing is even older than culture, as animals also play (Huizinga, 1955). When playing, there is fun and enjoyment. The game, as a structured way of playing, has four characteristics: a goal, rules, a feedback system and voluntary participation (McGonigal, 2011). One of the types of games developed in the last decades is the megagame. A Megagame, is a game played by several to hundreds of people that are often organized into teams. Usually, teams of players take on specific roles. The duration of a megagame could go from a half day (a megagame is a bit like a board game) to a weekend, and could be split into turns (megagame assembly).

The games are designed to be challenging, interesting and fun. They usually simulate a complex social, political or military situation (megagame-makers). They generally involve a combination of board game-style mechanics and role-playing elements (megagame assembly). The game designer sets up the background and objectives and at the same time. Players have to oversee resources and work towards objectives (megagame assembly). Resources need to be managed as they are scarce, creating interesting decisions and strategy. Examples of restricted resources could be money, technology, information or materials (Rycroft-Smith, 2016).

Megagames, as many other types of games, can be used as an educational tool. There are several examples of its application at HE levels in different countries. One example is ALLIANCE, a political science simulation

megagame by Shawn Mcmillan (2015). Another example is the game “VIRUS: Bunny Apocalypse” by Ted Castronova. Both were played in the United States.

Another example was conducted in 2020 at Linköping University. This Climate Change megagame is part of an on-going research project that looks to propose discussion around the topic by engaging players in real-life experiences and role-play.

In Mexico, research of megagames is almost non-existent. Nonetheless, gamification has been previously explored in various studies, mostly conference proceedings on the matter (González & Montalvo, 2018). There have been electronic games created by nationals, such as Robledo-Rella's (et al., 2017) Cocogame, which was used by Tecnológico de Monterrey's undergraduate students and González & Montalvo's (2018) BluRabbits internet based platform also helps to create different types of learning experiences.

2.3 Wicked Problems in Higher Education

Cities all over the planet are facing several challenges known as Wicked Problems (Buchanan, 1992; Coyne 2005; Irwin 2011; Rittel & Webber, 1973). Climate change, drought, obesity, poverty, racism, waste management, homelessness, crime, loss of biodiversity and water insecurity (Sarni, 2021) are some examples of this high complex, unsolvable and undetermined (Rittel, 1973; Buchanan 1992) system problems which are interrelated, interdependent and impact increasing numbers of people and other living beings (Gideon and Irwin, 2021).

Coyne (2005) has pointed out the complexity of what Wicked Problems (WP) are. In his revision of Rittel and Weber's (1973) definition of such, where the authors note that these problems normally appear in a social context, Coyne notes the following regarding WP:

“[They] persist, and are subject to redefinition and resolution in different ways over time. Wicked problems are not objectively given but their formulation already depends on the viewpoint of those presenting them” (p.6).

Lönngren & Van Poeck (2021) note that not only are these problems complex, but that their definition itself is not fully conceived by all in the same manner. This, they note, is the result of multiple theories involved and the lack of having a grounded consensus in what is and is not a wicked problem.

Ritchey (2013) also sees WPs as part of various areas and their planning. He provides a characterization of these by providing ten different criteria, which are the following: 1) They do not have one sole formulation; 2) They do not have rules that indicate when or where to stop; 3) Their solutions are better or worse; 4) They do not possess an ultimate solution; 5) WPs have attempts that has consequences; 6) WPs can have no solution whatsoever; 7) Each WP is unique; 8) A WP can be the result of another WP; 9) The causes of some WPs can vary; and 10) The end of a WP is not to be right or wrong, but to provide positive change for the specific WP. In addition, The author notes that WP “[are] ambiguous and associated with strong moral, political and professional issues” (p. 2).

In addition to this previous framework, Irwin and Gideon (2021) provide other relevant characteristics of WP: 1) they involve designed artifacts, communications, built infrastructure, technology, interactions and most importantly—people—which makes both their structure and behavior highly complex; 2) they reveal at different levels of scale, have multiple root causes and are interconnected among them; 3) it is important to consider other species and members of an ecosystem with conflicting agendas, affinities and dislikes; 4) they are governed by positive and negative feedback loops. Positive feedback occurs when a small intervention in the system quickly amplifies. Meanwhile, negative feedback involves attitudes, beliefs, values, behaviors and practices that represent ways of thinking and acting that affect the scenarios; 5) they cannot be solved from a fragmented disciplinary approach. It is necessary a multidisciplinary and holistic point of view or in other words, a systemic response; and 6) WP manifests in place, cultural and ecosystem-specific ways.

2.4 Water: A Wicked Problem From a Global to Local

According to THE United Nations Children's Fund (UNICEF) (ONU, 2019), 2.2 billion people do not have access to safely managed drinking water services; 4.2 billion people lack safely managed health services; water scarcity affects four out of ten people and eighty percent of waste water returns to the ecosystem without being treated or reused. The agricultural sector is the largest consumer of freshwater, responsible for almost 70% of water withdrawals worldwide. In Mexico, 60% of drinking water comes from surface water bodies. Of the main rivers, seven represent 71% of the country's surface water, located in the center and south of the country, while only

29% of the surface water is located in the north. Mexico is a country vulnerable to droughts with 52% of its territory located in an arid or semi-arid climate.

Hermosillo, the capital of the State of Sonora, is an emerging city with potential and a great opportunity to become a sustainable city. It is located in the northwestern region of Mexico. It has an urban population of 799,165 inhabitants and it is located in the Sonoran desert, which extends through the states of Sonora and Baja California, and through the southern states of Arizona and California in the United States. This desert is characterized by its high temperatures during the summer and low rainfall.

The city's challenge is related to its water security, being a city located in a desert climate and highly vulnerable to the effects of climate change. The growth of the city and the conflicts associated with the uses of the resource have led to a continuous search for new sources of supply. Nowadays, seventy one percent of the water used is extracted from the underground; this has caused a rapid depletion of water reserves. Climate change and water are interrelated WP where multiple stakeholders such as the public and private sector, non-governmental organizations, and civil society impact. If not properly addressed, the effects of climate change on water availability could have far-reaching consequences.

3. Methodology

Kuxtal was born from a Discipline Update Course (*CADI*) addressed to Higher Education educators organized by the Tecnológico de Monterrey HE institution in the summer of 2021. It consisted of knowing the methodology of megagames as an educational innovation strategy, so teachers could apply this playful resource in the classroom. Alejandro Andrés Iparraguirre, a professor at Universidad Nacional de Quilmes, a producer, designer and cultural manager of the video game industry, was the instructor who provided the tools to build the dynamics of a megagame (Narrative, Physical-Digital materials, Temporality, Role play, Set Up, Phases and Rules).

The project was a collaborative effort and was carried out over three days. Kuxtal, it was designed by seven professors from different locations and disciplines: Diana Cruz, Leticia Ramirez and Monica del Rosario Vargas from Monterrey, Camilo Duque from Leon, Edgar Ludert from Sonora Norte, Norma Ortiz from Santa Fe and Brenda Plata from Puebla, all of them Tecnológico de Monterrey campuses. Each of the members contributed with ideas that impacted on the elements that made up the megagame.

The megagame had three objectives: 1) Increase motivation of Higher Education students; 2) Increase awareness of Higher Education Design students over water issues locally and globally and 3) Develop research, reflection and action through the dynamics of a megagame.

We aimed to raise awareness among students about the problems related to water. Because water is the most vital element for existence, we decided to name this megagame Kuxtal, which means "life" in the Mayan culture. The game's narrative consisted in the simulation of a parallel world divided into 4 towns (north, south, east and west) which had become desert and hostile. This had given rise to the annihilating gray monster and its retinues, the humanoids, detestable beings who would do everything possible to keep Kuxtal dry, polluted and lifeless. Once the affected areas are removed, the monster and their allies are defeated. In other words, the teams should use "constructive cycles" to recover the availability, well-being, health and conservation of water.

Kuxtal involves real-life issues and science-fictional elements in order to provide students an immersive narrative that develops their critical-creative thinking skills and promotes their interest in research and development activities. The physical game itself consisted of original materials designed with the aid of Artificial Intelligence (AI) to create the pilot version (1.1) of the game.

Kuxtal gaming consists of 8 PHASES: 1.Beginning of the journey; 2.Pay Kux; 3.Towns dice; 4.Monster and Shaman; 5.Purchase of cards; 6.Cards activation; 7.Healing Kuxtal; 8.End. There is a loop between phase 2 and 7, once Kuxtal is healed completely, the last phase is enabled. The overall game had players divided into teams (towns) during six days of play in synchronous (in the classroom) and asynchronous (remote) time. The teams had to earn Kux (water stone tokens) through service learning, research, and critical thinking activities to get activation cards; which promote action (Ex: water a plant in your community at night), research (Ex: what is virtual water and mention 3 relevant examples), reflection (Ex: water, just as it is life, is also death) and exploration (Ex: explore rain harvesting systems and select the most appropriate for your community) (see Figure 1).

The students transform into *the guardians of water* and randomly into the *shaman* and the *gray monster*. Daily, the elements are set up on the floor, including the map, *Tuccum* cards (gray cards), *Kaxan* cards (yellow cards), *action-reflection-research* (dark and light blue cards) , town dice and the monster and shaman summon tokens.

The guardians have to validate the cards by presenting their corresponding evidence that is registered by the teacher (see Figure 2). The game ends when the four towns remove the 20 gray Tucuum cards from Kuxtal.



Figure 1: Kuxtal mega game pieces and water stones

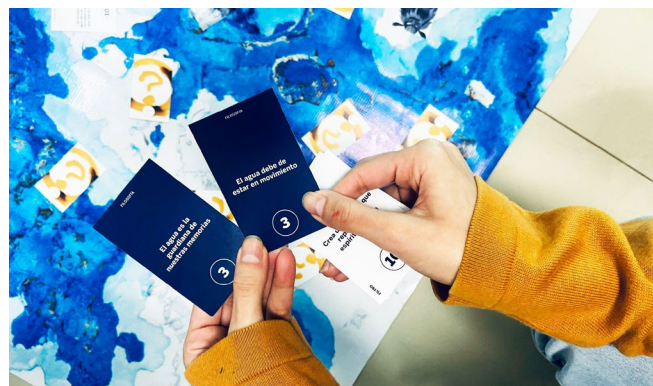


Figure 2: Kuxtal megagame reflection cards

3.1 Game Rules and Mechanics

3.1.1 Lot

Kuxtal, a world that once was blue and full of life, today is gray and dry thanks to the gray monster and its followers, the humanoids, despicable beings that are against water and all living things. These feed on pollution, droughts and all those acts that harm the most important living being: water. But there is hope! The last 4 guardian villages will need to ally with the shaman, together with his divine rituals, will fight to heal Kuxtal and turn it back into an oasis full of life.

3.1.2 Temporality

The game lasts about a week, between 3 and 5 hours in total. 30 synchronous minutes and 30 minutes asynchronously are played daily depending on the time assigned by the teacher.

3.1.3 Materials

Game element	Description
Kuxtal Map	1x1mt printed canvas with the 4 territories. This is placed at floor level. Educators can choose the size of the printed map so it conveys its budget and space.
1 Towns dice	Tetrahedron dice that contains 2 times each of the towns. This is used to select which town will control the monster and which town will control the shaman each day.

Game element	Description
Monster tokens	Contains negative effects that affect Kuxtal.
Shaman tokens	Contains invocations that give Kux to the guardians of water.
20 action cards	Dark blue cards that imply an embodiment of activity, mobility, participation of an external person, among other traits.
20 reflection cards	Light blue cards with quotes that inspire reflection about water.
20 research cards	Light blue cards that involve doing basic research about a concept, case study, author, information, etc..
20 Kaxan exploration cards	Yellow cards that need artifacts to be activated. Once flipped, these cards give special powers and Kux.
20 Tucuum cards	Gray cards that need to be removed from the map, each one has a symbolic text that represents a negative effect.
200 Kux	Stones of different shapes and blue colors. They can be obtained by activating and achieving the card's commands. (There is freedom to use any kind of materials)
1 box	Container that stores all the pieces.
1 blackboard or 1 Laptop	It is used to register the activated cards, either during the current day or the next day. If the educator has a computer, it is feasible to carry out the registration digitally.
1 pencil	Any instrument used to record information.
1 shamanic collar	Optional, works for role play and personification.
1 monster hat	Optional, works for role play and personification.

3.1.4 Roleplay characters

GUARDIANS OF THE WATER	During the game, all the students transform into the guardians of the water and they are divided into the four different towns. Its aim is to carry out positive actions to heal the Tuucum areas. As a community, they decide how they use their Kux, and their tools to get cards. They must contemplate that they need to pay 1 Kux daily to be alive and continue playing.
WATER ANNIHILATOR MONSTER	Each day, a town becomes the monster, which will affect Kuxtal with negative points dictated by its dice.
SHAMAN	Every day, a town randomly summons the shaman. He decides which town (other than the shaman's) will benefit from the ritual dictated by his dice. The town, together with the shaman, will carry out the ritual to obtain Kux.

3.1.5 Setup and phases

SET UP	Students are divided into 4 teams (there must be a balanced number of water guardians per town. There may be a difference of 1 person in some teams) Teams choose the name of their town Place the map on the floor Place the Tucuum and Kaxan cards randomly on the map. Place on the blackboard (physical or digital) the 4 towns and their respective members. Place the light and dark blue water card decks into the edges of the map Place the additional elements near the map: The towns dice, the summons of the shaman and the monster.
PHASE 1 PAY OF LIFE	To start the game, each player must pay 1 Kux daily to stay alive. If some of the guardians don't have Kux, they can borrow from other towns.
PHASE 2 TOWNS DICE	The town's dice is rolled to choose who will activate the monster and who the shaman.
PHASE 3 MONSTER AND SHAMAN	The town with the monster rolls the dice to choose where the negative points will affect. The town with the shaman choose one random invocation and applies its Kux reward.
PHASE 4 PURCHASE OF CARDS	The town in turn will choose which cards they want to buy. The teacher will collect the Kux corresponding to the cost of that cards. Ex. Town X buys 2 action cards (2 + 2) and one reflection card (1) giving a total of 5 Kux. This stage is until the 4 towns purchase cards.
PHASE 5 ACTIVATION OF CARDS (ACTION, RESEARCH, REFLECTION, EXPLORATION)	The town in turn will choose which cards want to activate. The team reads the description of the card aloud. Ex. Town Z activates a reflection card (+3), discussing what the card command is. Likewise, they activate an action card (+10), which involves watering a plant in their community. The teacher will reward them with 13 Kux. Action and research cards will generally be charged the next day, cause these activities are planned to be performed asynchronously. If a town has any tool derived from the action cards, this turn it will be able to access the exploration or Kaxan areas indicated on the yellow cards on the board. As long as the people do not obtain any tools, they will not be able to access the Kaxan areas. This stage is until the 4 towns activate their cards.
PHASE 6 / RELEASE TUUCUM AREAS	The town in turn will decide how many Kux will be used to eliminate the gray cards or Tucuum zones in the map. If a town is left with a zero Kux balance, they must borrow from the other towns to continue playing the next day. This will happen only 2 rounds.
PHASE 7 END OF THE GAME	The game ends when the four towns remove the 20 gray Tucuum cards from Kuxtal. Each town will make a final reflection on the experience that the megagame left them.

3.2 A Megagame in Tecnológico de Monterrey

The Architecture, Art and Design School at Sonora Norte campus is focused on developing projects that impact the real-life scenarios of students. Therefore, we addressed WP with design approaches. The design praxis that we are trying to promote is the one that not only sustains but regenerates. Through our practices and interventions into culture, design can make a positive impact into our immediate local context.

It was tested during the second and third week of the Thinking and Creative Process course in the fourth semester of the Industrial Design degree. This topic lasts 5 weeks and is research oriented. This 2023 is the third year in which the water challenge is promoted on a national level. This means that we have to create projects that attend to problems related to water. Some examples that students designed are; an hydroponic garden that reuse gray water; a public fountain that collects rainwater and a water filter saver that is oriented to parents that want to educate their children around ecological practices. This initiative impacts directly into the Sustainable Development Goals (SDGs) 6; Clean water and sanitation, however it also relates to SDG 3 (Good Health and Well-Being), and SDG 11 (Sustainable Cities and Communities).

The participants were 24 students from Tecnológico de Monterrey Sonora Norte campus. Of these students, 2 were male, and 22 were female. The students belonged to the fourth semester of the Industrial Design degree. To analyze motivation, we administered the Brett D. Jones (2021) MUSIC model, which can be used in any subject area at any grade level (a) to design instruction that motivates students, (b) to diagnose motivational strengths and weakness of instruction, and (c) to research relationships among factors critical to student motivation. The five principles of the model are as follows: “The instructor needs to ensure that students: 1; feel empowered (...) to make decisions; 2. understand why what they are learning is useful (...); 3. believe that they can succeed if they put forth the effort required; 4. are interested in the content (...), and 5. believe that others in the learning environment (...) care about their learning and about them” (Jones, 2018, p. 9).

The contextualized version of the MUSIC model had 26 items and were divided into five components: Empowerment, Usefulness, Success, Interest, and Caring. Empowerment and Usefulness use five questions, Interest and Caring six questions and success four. All items used a 6-point Likert scale describing 1 (Strongly disagree), 2 (Disagree), 3 (Partially disagree), 4 (Partially agree), 5 (Agree) and 6 (Strongly agree) (see Annexe 1). The data obtained was kept anonymous so the answers to the survey items could not be linked to individual participants.

4. Results

Once the survey of 26 items was conducted, we analyzed the information collected and were surprised by the answers. The answers related to our first objective (the use of megagames to enhance student-motivation) returned favorable towards the methodology used in the session for the study.

- 1.The course activities catch my attention.
- 2.I have the opportunity to decide for myself how to achieve the objectives of the megagame.
- 3.In general, the activities of the megagame are useful.
- 4.The teacher is available to answer my questions related to the activities of the megagame.
- 5.Megagame activities are beneficial to me.
- 6.The teaching methods used in this megagame call my attention.
- 7.I am confident in my ability to successfully perform the activities of the megagame.
- 8.I have the freedom to carry out the activities of the megagame in my own way.
- 9.I enjoy the teaching methods used in this megagame.
- 10.I feel capable of meeting the academic challenges of the megagame.
- 11.The teaching methods involved me (engage) actively in the megagame.
- 12.I have different options to achieve the goals of the megagame.
- 13.I enjoy megagame activities.
- 14.I consider myself capable of getting a high rating in this megagame.
- 15.The activities of the megagame seem interesting to me.
- 16.The teacher is willing to help me when I need it.
- 17.I have control over how I learn the contents of the megagame.
- 18.Through the megagame I have felt that I can successfully carry out the activities.
- 19.I consider the megagame activities to be relevant to my future.

20. The teacher cares about my performance in the megagame.
 21. I will be able to use the knowledge gained in this megagame.
 22. The teacher is respectful to me.
 23. The knowledge gained in this megagame is important for my future.
 24. The teacher is friendly
 25. I think the teacher cares about how I feel.
 26. What I am allowed to do in this megagame is flexible.

Figure 3: Survey questions for participants based on the Music Model (Jones, 2021)

For our first inquiry in the study (do megagames motivate student-learning in a Design degree in HE?), the participants answered in favor of megagames as a motivation tool for their learning process. For example, statement 9 (I enjoy teaching methods used in this mega game) showed that 17 out of 24 participants strongly agreed with it (see Figure 4). While 3 agreed, 2 partially agreed and only 1 was in disagreement and another one strongly disagreed with the statement. Answers were almost similar in statement 6 (The teaching methods used in this megagame called my attention): 18 strongly agreed, 4 agreed, 1 was in disagreement and another one strongly disagreed (see Figure 5). In addition, statement 5 (Megagame activities are beneficial to me) were answered the same as in statement 9.

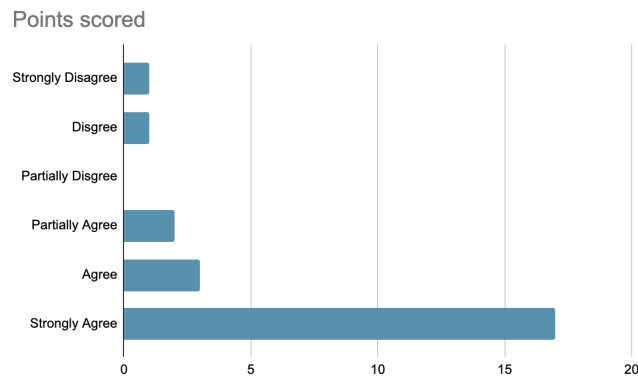


Figure 4: Graphic representing participants answer to statement 9 (I enjoy the teaching methods used in this megagame)

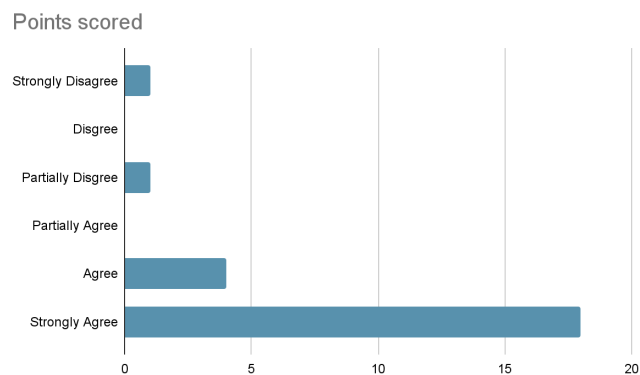


Figure 5: Graphic representing participants answer to statement 6 (The teaching methods of the megagame call my attention)

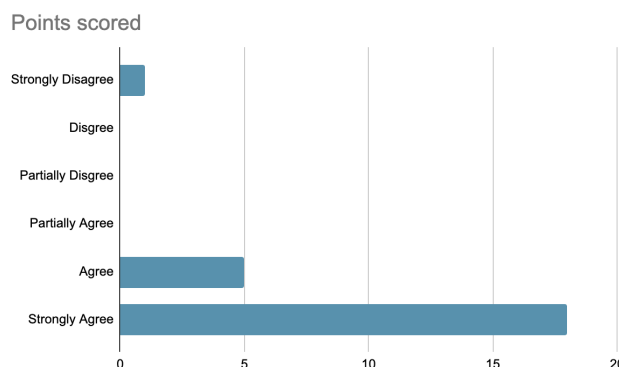


Figure 6: Graphic representing participants answer to statement 21 (I will be able to use the knowledge gained in this mega game.)

On the other hand, the answers to our second objective (if research and action was developed among students through the megagame), the responses from the participants on statements 19, 21 (see Figure 6) and 23 offer an insight on how the participants viewed the overall activity (which involved a megagame and research methodology) as useful towards their future activities. We interpreted this as a positive attitude towards not only the research methodology and the megagame itself, but as a useful tool and methodologies for students' future endeavors, whether in research projects or in their decision-making.

5. Conclusions

Megagames can be a playful response and approach to the understanding of wicked problems. Inside the classroom, educators can call educational innovations that impact not only in how the contents are shared, but in the motivation of students, so they can fully get involved in the phenomenon and its research process. Kuxtal was an opportunity to trigger collaboration, play, critical-creative thinking and actions that impacted on the real-scenarios of students, on their immediate context, community and discipline. This is an invitation to other educators that want to create immersive learning experiences and divergent methodologies that motivate students to think, learn and act. We believe that the process of the game creation could be highly enriched by the participation of multidisciplinary backgrounds educators.

In addition, we suggest further studies of the design and implementation of megagames in Higher Education (HE) scenarios, whether in an Arts undergraduate program or another program that requires students to collaborate and create solutions through serious play, research development and involvement with their immediate communities, all while reaching target goals in their learning outcomes. This, especially, should be explored as a useful alternative to motivate students in HE to participate in the research community at an undergraduate level and get involved in the solution of wicked problems. Even though this megagame was tested only once, it showed promising results. Finally, Kuxtal is an open source megagame that can be downloaded (spanish version) in the next url <https://tinyurl.com/kuxtalMegagame> so educators can print and use this water awareness research kit in their classroom.

Declaration of interest

This is to acknowledge that the authors report there are no competing interests to declare.

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