Promoting 21st Century Skills with Game-Based Learning in Interdisciplinary Fisheries Education

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Abstract: This conference paper presents the case of using a combination pre-made serious games and self-designed games at bachelor and master's programs at the Norwegian College of Fisheries Science to facilitate the integration of different disciplines and the development of practical skillsets that are necessary for success in the seafood industry after graduation. Furthermore, it explores the preliminary results of student surveys rating their experiences of game based learning in the bachelor in fisheries and aquaculture science program.

Keywords: Game-based learning, interdisciplinary programs, fisheries science, student-active learning, constructive alignment

Introduction

Aquaculture, small-scale and industrial fisheries are primary industries that are a source of food, employment and recreation for people all over the globe (FAO 1995). In 2018, the seafood export from Norway exceeded 10 billion euros (Seafood Norway 2019). The study of this important industry, Fisheries and Aquaculture Science, is an interdisciplinary field. It combines natural and social sciences in order to provide graduates with the necessary disciplinary knowledge, skills and competences for working in the seafood industry or management (Charles 1995). A graduate with a Bachelor's degree in Fisheries and Aquaculture Science (BFA) combines disciplines thar range from aquatic biology, via seafood production to the process of management planning. In addition to combining diverse academic fields, fisheries science and aquaculture science can also be considered to be transdisciplinary, due to the close connection between the academic community and both the seafood industry and governmental marine resource management (Tress, Tress & Fry 2006).

Although BFA graduates combine a variety of disciplines, their knowledge is still highly specialized. There is currently a focus on higher education institutions' obligations to not only offer a high quality academic education, but also provide their graduates with the skills needed to succeed in the workforce. As business, industry and management have become more complex, the role of the worker or manager has transformed. There is less use for routine skills, but the ability to communicate, share and use information efficiently has become more important. In addition to communication, key skills include collaboration, problem solving and critical thinking. A brief definition of these skills is provided in table 1 (P21 2019). The collective term for these skills are "21st century skills", not because they did not exist earlier, but due to the transformation our society has undergone, our reliance on them has increased (Binkley et al 2012). The use of internships at industry partners is one way to provide arenas for students to learn these skills during their education, but game-based learning is another method that is suitable for achieving these learning outcomes. Kivunja (2014) reviews the literature on effective teaching and the new learning paradigm that can provide students with the 21st century skills, and stresses the importance of educators providing students with effective training in the skills in order for them to be prepared to apply them when they start their professional careers. Moving from passive teacher-directed teaching to active student-centered learning is a central step towards promoting 21st Century skills.

Table 1: P21 Framework definitions of 21st Century Skills (P21 2019)

21st Century Skill	P21 Framework definition
Communication	Articulate thoughts and ideas effectively using oral, written, and nonverbal communication skills in a variety of forms and contexts; Listen effectively to decipher meaning, including knowledge, values, attitudes, and intentions; Use communication for a range of purposes (e.g. to inform, instruct, motivate, and persuade); Utilize multiple media and technologies, and know how to judge their effectiveness a priority as well as assess their impact; Communicate effectively in diverse environments (including multi-lingual).

Solve Problems	Solve different kinds of non-familiar problems in both conventional and innovative ways; Identify and ask significant questions that clarify various points of view and lead to better solutions.
Critical Thinking	Use various types of reasoning (inductive, deductive, etc.) as appropriate to the situation; Use systems thinking; Analyze how parts of a whole interact with each other to produce overall outcomes in complex systems; Make judgments and decisions; Effectively analyze and evaluate evidence, arguments, claims, and beliefs; Analyze and evaluate major alternative points of view; Synthesize and make connections between information and arguments; Interpret information and draw conclusions based on the best analysis; Reflect critically on learning experiences and processes.
Collaborate	Collaborate with others; Demonstrate ability to work effectively and respectfully with diverse teams; Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal; Assume shared responsibility for collaborative work, and value the individual contributions made by each team member.

At the Norwegian College of Fishery Science (NCFS) at UiT The Arctic University of Norway, the bachelor and master programs in Fisheries and Aquaculture Science are being revised in order to better the students' acquisition of 21st century skills. Central in this is the big-tent concept of student-active learning. Michael (2004) provides a useful overview of different types of learning methods included in the big tent: Activity, collaboratively, cooperative and problem-based learning. BFA has a traditionally well-established use of research cruises and laboratory course, added have added new activities that includes student internships at relevant businesses and game-based learning. This paper presents the implementation of the game-based learning (GBL) at NCFS, which serve as a combination of the approaches from Michaels (2004), as well as preliminary results from the student evaluations of the GBL activities.

Through the use of GBL, students are provided with opportunities to both integrate the different components of the program, and apply them in a an authentic learning environment that promotes 21st century skills (Qian & Clark 2016). Moreover, game-based learning also provides opportunities for students to relate their theoretical skills and practical skillsets on complex and broad concepts, promoting deeper learning on issues such as sustainability (Blanchard & Buchs 2015). The GBL approach used at NFCS is mainly focused on hybrid board/roleplaying games with some computer support.

Sustainable resource use is highly topical, and this paper relates the current literature on game-based learning and 21st century skills to a practical example of a higher education program that is oriented towards a growing industry. The lessons are relevant for other fields, both in terms of transferability and comparison. This paper is based on preliminary results.

Models for Game-based Fisheries Science Education.

Before presenting the implementation of game-based learning on NCFS, I will present some models that explain the underlying concepts of the teaching scheme. The foundational idea behind the instruction in the interdisciplinary bachelor in fisheries and aquaculture science program is constructive alignment: The learner constructs understanding through what they do to learn, which can be promoted by aligning the learning activities, learning outcomes and assessment tasks. This means that the focus is on what and how the students are supposed to learn, instead of on the overall academic topic of the course (Biggs & Tang 2011). Constructive Alignment is illustrated in figure 1:

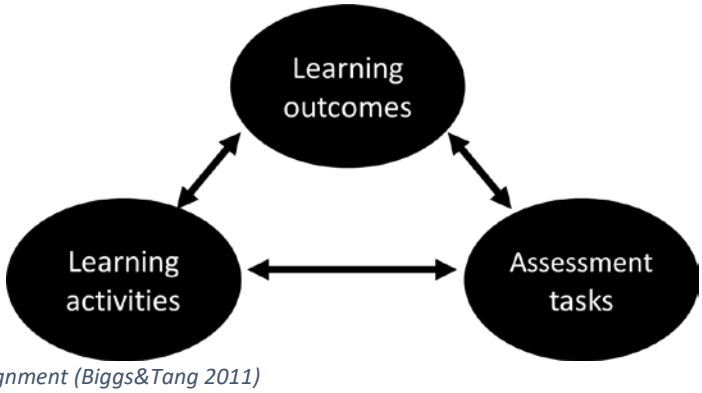

Figure 1: Constructive Alignment (Biggs&Tang 2011)

Fisheries and aquaculture science deals with complex, socio-ecological systems where different human and natural systems are interlinked (Fischer et al 2015). Environmental literacy is one of the interdisciplinary themes identified in the 21st Century Skills framework (P21 2019), and fisheries and aquaculture represents a good context for exploring this theme. In addition to understanding how different academic disciplines fit together, students of fisheries science must also link these skills to how complex issues affect each other across local, regional and global scales. Games offer opportunities for educators to operationalize and promote complex topics through simulation games. McCall (2016) puts forth the following definitions of games, simulations and simulation games:

- Games: "have players engaged in an artificial conflict governed by rules to achieve one or more predetermined goals with some form of quantifiable outcome, i.e. winners and losers, scores, etc."
- Simulations: "are dynamic—in the sense of their variables being manipulable—and simplified models of reality that have a degree of verisimilitude" and "pedagogically mediated (…) in that teachers intend them to be educational in some sense"
- Simulation Games: "occupy that middle ground as games—dynamic, rule-based and quantifiable conflicts—that provide playable models of a historical event, system, or process".

By these definitions, the games used at NCFS are closest to being simulation games. Peters & Westelaken (2014) provides a design model for translating a complex real-world situation to a simpler model in a simulation game, as shown in figure 2:

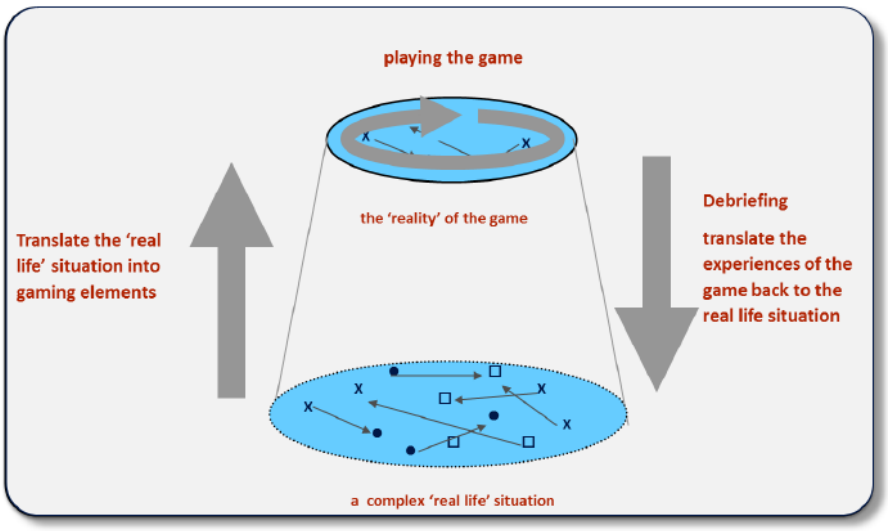

Figure 2: The Process of Designing and Applying Simulation Games for Complex Problems (from Peters & Westelaken 2014).

The elements that are necessary for illustrating the core situation are included, while the less important elements are abstracted or represented in other forms, creating a version of the reference system which is less complex. At NCFS this has in practice been done by the participation of subject matter experts in the design (or and adaption) of and running the games used, in order to align the content of the game with 'real life'. Through playing the game and structured debriefing, the players relate their experience of the simplified model to the real life situation.

Garris, Ahlers & Driskell (2002) offer a concise model of the input-process-outcome flow of an instructional game, which is useful for understanding the experience of participating in GBL, illustrated in figure 3:

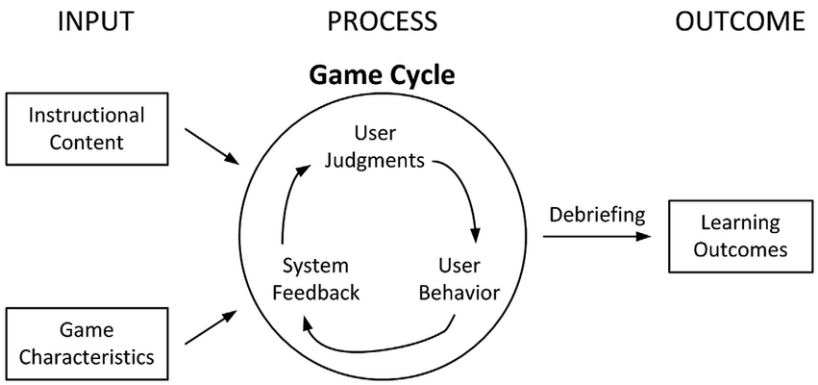

Figure 3: Input-Process-Outcome Game Model (from Garris et al 2002)

In a GBL activity, the instructional content is combined with the game elements and provides the learners with a cycle of gameplay, feedback and assessment. In the context of constructive alignment, this loop is an arena where the learners construct their understanding from performing the learning activities. By making decisions, evaluating the feedback from the actions taken, and making revised decisions, the learners get an experience, or simulated praxis, that can be related to the curriculum and overall topic. A key element for attaining the learning outcomes is structured debriefing, where the learners' experiences from the game cycle are reviewed and analyzed, and linked to the bigger picture. Where the simulation game simplifies reality in order to make it playable, debriefing allows the learner to decompress the simplified model and apply the experience to the real world (Garris et al 2002). The seminars and lectures that follow the GBL use the games as examples, and further relates to the concepts in the curriculum and practical application. An important element of this is to make sure that the learners get an opportunity to explore any potential issues connected to dealing with a complex situation translated into a simplified game. As with the design or adaptation of the games used at NCFS, an important element is that the educators involved in running the games are also the subject matter experts on the topics that are being explored through the GBL. The GBL is designed and carried out in order to provide a form of classroom praxis, from which the broader learning outcomes are engaged with as the course progresses.

Debriefing is not only important for the construction of understanding, but also for completing the experience for the participants. Nicholson (2012) points at the importance of also focusing on the particulars of the activity, and the learners' assessment of how the activity worked for them and how it contributes to their learning experience.

Game-based learning at the Norwegian College of Fishery Science

Games are one of the pieces in the student active learning environment at NCFS, in combination with internships, research cruises and laboratory courses. This means that games are not used in all the different classes. The GBL is intended to teach both core topics in the course curriculum, but also provide the learners with an arena to integrate their knowledge from the whole of the program, as well as practicing 21st century skills such as communication, problem-solving and critical thinking. GBL has been chosen as the method to achieve these goals since they provide both a form of simulated praxis that takes place in the classroom, and the common thread that helps learners "connect the dots" and understand interactions in complex systems. The combination of student-active approaches allows the learners to engage with and gain deeper knowledge on intricate topics through activities that are collaborative, cooperative and problem oriented and also gives effective training in 21st Century Skills (Blanchard & Buchs 2015, Michael 2004, Kivunja 2014). In the context of the BFA, GBL offers an approach that provides alignment between the activities and learning outcomes that goes beyond the traditional instruction methods of lectures and seminars.

This paper will cover the use of three games: The commercially available *Fish Banks Ltd.* (Meadows, Fiddaman & Shannon 1993), and two games developed at NCFS: *the Green Grouper Social Simulation Game* (Weines et al 2017), and *Go n' Fish – Fishing for Knowledge*. In addition, various forms of case-based roleplaying games are used in different courses, for instance in order to teach about the process of establishing marine protected areas. A game about differences in fisheries structure and quota systems, and one about sustainable value chains in seafood production are also in development.

Go n' Fish – Fishing for Knowledge is a knowledge game where the students prepare questions from the curriculum throughout the semester, and use the game in preparation for exams. This game has been used in a variety of courses, including scientific methods, seafood production, marine resource management and fish biology. The main concept of the game is that in addition to preparing the questions for the game, there is no answer sheet for the questions and the players have access to their textbooks and other study material when they play and also acts as jury. This facilitates a talk-and-play cycle that engages the learners, and goes beyond being a form of quiz or test in a different format. This model counters some of the criticism of trivia games in Game-Based Learning, as described by Nicholson (2011). In addition to being used in the teaching, the game has also been used as part of the oral exam in a marine resource management course. *Go n' Fish – Fishing for Knowledge* has also been implemented as part of the teacher's education program at UiT The Arctic University of Norway, and an article based on experiences from using it in the different programs is currently in progress (Strandbu, Weines and Esaiassen, forthcoming).

One of the main game-based learning activities is a combination of *Fish Banks Ltd*. and *the Green Grouper Social Simulation Game* (GGSSG). Students on the first semester of BFA play these games as part of an introductory course on marine industries, and they replay the games at a later stage in the program. The themes of these two games are connected. *Fish Banks Ltd.* (Meadows, Fiddaman & Shannon 1993) explores the tragedy of the commons (Hardin 1968). The learning outcomes for the game when used in BFA are shown in table 2:

Table 2: Learning outcomes for Fish Banks Ltd. in BFA.

Attain insight in central challenges in marine resource management, and the most important international developments in the field;
Be able to reflect over choice of management methods;
Be able to work with practical challenges in marine resource management;
Account, orally and in writing, for ecological, economic and social consequences of management measures;
Evaluate when and how management measures should be implemented.

Teams of players control fishing companies that invest in fishing vessels to exploit two fish stocks, one coastal and one deep sea. The goal is to gain the most profit, but as the fishing pressure increases the stocks will decline and be unable to recover. Through playing this game, the students experience how the lack of effective management makes it hard to exploit a renewable resource in a sustainable way when the main driver is profit. As part of the debriefing and in the lectures and seminars following the game, the students learn about the post-Hardin work on the tragedy of the commons (Ostrom 1990). When the students replay the game later in the program, they play a modified version where the game is run in a way where the students to a larger degree can find and agree on a solution to avoid a crisis in the fishery, and there are more arenas for negotiations between the teams. This version involves that the game-master to a larger extent is willing to provide some incentives for keeping fishing vessels in the harbor, without removing the tension of whether or not some of the companies will break the agreement in order to gain additional profit.

GGSSG (described in Weines et al 2017) is developed at the NCFS. In the game, the players take the role of independent fishery management professionals who are competing in an open call for a management plan that can end an ongoing fisheries crisis in a fictional country. The learning outcomes are outlined in table 3 below:

Table 3: Learning outcomes of GGSSG.

Experiment with the interdisciplinary complexities in making and implementing management plans, and explain the basics about marine resource management;
Appreciate the interdependence between the management actions and the three sustainability pillars (Economic, Environmental and Social sustainability);
Experiment and explain that no perfect management plan exists, but many possibly viable solutions do.

The game is a hybrid board/roleplaying game with some computer support. The game allows the players to explore the framework of social processes that constrain and influence how fisheries management plans are made, and how the different elements of sustainability (i.e. the economic, environmental and social dimensions) relate to resource management. It is played in groups, with the players spending limited resources to get access to new management tools (such as quota systems or government initiatives) and information about their effects,

and how they are received by the different stakeholders in the country where the game takes place. The game's scenario takes place in a fictional country, and an important tool for the players is the scenario description that gives them information about the world they are making decisions in. Over the course of the game, the players will combine up to nine management tools in their plan. As the game progresses, the complexity of the plan increases as more management tools and evaluation criteria are added. Finally, the groups present their management plans, arguing for why their suggested approach is the best solution. In the end, the game-master, in the role of the Minister of Fisheries, will decide if any of the plans will win the competition. In the debriefing and teaching that follows the game, the students learn more about the current scholarship and status of national and international management systems and implements.

When played sequentially, *Fish Banks Ltd.* and *the Green Grouper Social Simulation Game* build on each other and provide the students with a common context and experience for debriefing and reflection on the overall course curriculum. The players are exposed to a learning environment where they have classroom praxis of both an unmanaged profit-driven fishery without the possibility of sanctions, as well as the problems of designing a governance system that has both an effective combination of management instruments and is acceptable to sectorial stakeholders and the authorities themselves. With the repeated plays, both in the beginning of the program and later when the learners have acquired more knowledge on various dimensions of fisheries management allows them to apply their competence at different stages in their expertise. Through preparing questions for and playing *Go n' Fish*, the learners engage with the curriculum in a process of peer learning, and the questions are also a part of the final oral exam. The instruction loop is illustrated in figure 4 below.

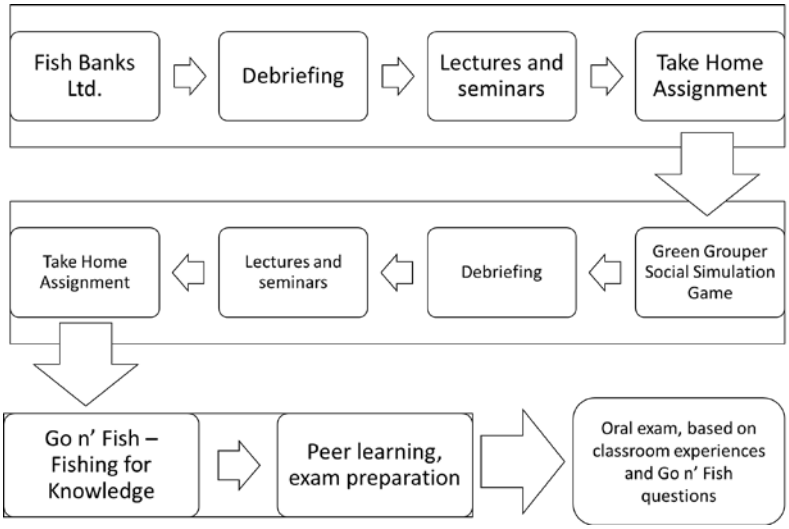

Figure 4: The instruction loop of Fish Banks Ltd., Green Grouper and Go n' Fish

Where the core of the learning outcomes from the games focus on topics related to fisheries, an important element is also the ability to practice 21st century skills. The applied learning, in groups, allows for the students to also practice a variety of skills, including communication, problem-solving, and critical thinking. Disciplinary knowledge and 21st century skills are not fenced off in different pastures, and practicing them in a context that makes sense for both is most effective (Rotherham & Willingham 2009). An overview of opportunities for skill trained in *Fish Banks Ltd.* and GGSSG is provided in table 4:

Table 4: Situations for practicing 21st Century Skills in Fish Banks Ltd. and GGSSG

Skills	Fish Banks Ltd.	GGSSG
Communication	Discussions within teams. Negotiations between teams.	Discussions within team. Presentation of the final management plan.
Collaboration, decision making	Deciding on strategy, whether or not to uphold non-binding agreements.	Prioritizing resource use, deciding on strategy.
Critical-thinking, problem solving	Evaluating the declining fish stock, allocating fishing vessels, deciding on when to stop expanding the fleet.	Evaluating combinations of management implements, figuring out why stakeholders does not react as expected, applying the information in the scenario to the game situation.

All of these skills are useful in workplace contexts, and are also important for the learning process. By providing the students with an active learning environment, the aim is that the games also contribute to metacognition, and facilitating that the students construct a bigger whole, learning to relate their academic learning to real-world situations.

Results from debriefing forms and end-of-program surveys

The main data for evaluating the use of game-based learning in BFA is collected through an end-of-program survey. This survey evaluates the entire program, and the analysis of it will be published in an upcoming article (Weines, Lien and Finstad forthcoming), which will also thoroughly explore the effect of other changes made to the program. Surveys have been collected from one cohort from before the introduction of games, and two cohorts that attended the program during the process of implementation. Shellman & Turan (2006) shows that their use of simulation games strengthened substantive knowledge as well as critical and analytical thinking skills. While their survey was done in the context of a simulation game, it offers a good review of analyzing students' own reporting of their experience with game-based learning.

This section is preliminary as the first cohort that started post-implementation have not yet finished the program and answered the survey. As the implementation is one part of several changes that were made to the program at the same time, and therefore the survey deals with several topics. For this conference paper we have extracted the questions that dealt with game-based learning and 21st century skills. The 2017 survey was collected from cohorts that started in 2013 and 2014 (N=22, 44,8% return), and the 2018 survey from students that started in 2015 (N=19, 31,6% return). For the 2017 survey 50,1% of the respondents were male, while the 2018 survey had 26,3% male respondents. As the surveys is sent out at the time the students have completed the BFA program and are graduating, we consider their responses to be reliable. As the recipients to a large extent have not been exposed to games during their time in the program, much of the data collected so far serves mainly for comparison to the surveys collected from the current and future cohorts. The first survey from a cohort where all the students participated in game-based learning will be collected in 2019, and a deeper analysis and model testing of the survey data will be performed when these results have been collected. The presentation of this paper at the ECGBL conference will include this analysis.

Short open-format surveys have been collected as part of the post-game debriefing. The responses from these forms, as well as the open responses will also be analyzed and included in the updated version of this conference paper. There are also open responses from the program surveys that have not yet been analyzed and integrated in this paper.

Table 5: Students' views on the BFA program as a whole.

Students' views on the BFA-program as a whole:	Disagree		Partly Disagree		Neither agree or disagree		Partly Agree		Agree	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
The program has given me an integrated understanding of the connection between natural science, technology and social science	0%	5,3%	4,5%	10,5%	9,1%	21,1%	45,5%	31,6%	40,9%	31,6%
It was easy to see how the different courses were connected and built on each other.	4,5%	10,5%	13,6%	26,3%	13,6%	31,6%	45,5%	31,6%	22,7%	0%
Through the program I have attained relevant practical skills	4,5%	15,8%	27,3%	10,5%	27,3%	15,8%	36,4%	42,1%	4,5%	21,1%

Table 6 Students reporting on integrated understanding and insight.

Rate the extent of you acquisition of the following knowledge, skills and competence	Very little		Little		Satisfactory		Good		Very Good	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Broad knowledge about the exploitation of marine resources on the basis of biology, technology, economy and social science	0%	0%	0%	15,8%	27,3%	31,6%	59,1%	47,4%	13,6%	10,5%
Understanding of interaction in the value chain in the seafood industry	0%	0%	0%	5,3%	13,6%	21,1%	72,7%	52,6%	13,6%	21,1%
Insight in national and international issues related to sustainable seafood industry	4,5%	10,5%	4,5%	21,1%	9,1%	36,8%	63,6%	31,6%	18,2%	10,5%

Table 7: Students' evaluation of learning activities based on learning outcomes.

Students' own evaluation of learning activities based on learning outcomes	Very little		Little		Satisfactory		Good		Very Good		N/A	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Games (board games, computer games, roleplaying games, simulations)	9,1%	10,5 %	9,1%	15,8 %	4,5%	21,1 %	13,6 %	26,3 %	9,1%	5,3%	54,5 %	21,1 %
Quiz, Kahoot and similar	4,5%	10,5 %	13,6 %	15,8 %	13,6 %	36,8 %	18,2 %	31,6 %	22,7 %	5,3%	27,3 %	5,3%
To what extent has FishBanks contributed to your learning?	9,1%	5,3%	0%	15,8 %	4,5%	21,1 %	0%	15,8 %	0%	0%	77,3 %	36,8 %
To what extent has GGSSG contributed to your learning?	9,1%	5,3%	0%	10,5 %	0%	10,5 %	0%	21,1 %	0%	10,5 %	86,4 %	36,8 %
To what extent has Go N' Fish contributed to your learning?	9,1%	5,3%	0%	10,5 %	0%	26,3 %	0%	5,3%	4,5%	5,3%	81,8 %	36,8 %

Table 8: Students' evaluation of game-based learning, debriefing and industry relevance.

Students' evaluation of the following statements:	Disagree		Partly Disagree		Neither agree or disagree		Partly Agree		Agree	
	2017	2018	2017	2018	2017	2018	2017	2018	2017	2018
Games have been a positive learning experience	9,1%	5,3%	0%	5,3%	36,4%	36,8%	18,2%	31,6%	4,5%	15,8%
Debriefing after the games was important for the learning outcome	4,5%	5,3%	0%	10,5%	50%	21,1%	13,6%	36,8%	0%	15,8%
Game-based learning gives a bad understanding of real issues in the seafood industry	9,1%	10,5%	13,6%	31,6%	45,5%	47,4%	0%	5,3%	0%	0%

As stated above, the current state of our data collection does not include many cohorts that have experienced the fully implemented game-based learning activities in the program. The response rate of the 2018 survey was also low (31,6%). We are therefore hesitant to make bold claims based on this data, and will revisit it when the 2019 survey has been gathered.

As shown in table 5, the students report a lesser degree of getting integrated interdisciplinary understanding, and experience of a common thread through the program. However, there is an increase in their reported acquisition of practical skills. Table 6 shows that the students report a general decrease in how they rate their acquisition of different skills, knowledge and competencies. The reasons for this will be further explored in Weines, Lien & Finstad (forthcoming).

From table 6 we see that most of the respondents in the data set have not had experience with games. The 2017 survey reports N/A from 54,5% of the respondents on the use of game-based learning (excluding quizzes such as Kahoot), with the corresponding 21,1% in the 2018 survey. The proportion that reports that they see little contribution to their learning outcomes from the games is low, and sees a small increase. The groups that reports that the contribution to learning outcomes has been satisfactory or better is also increasing.

Regarding table 5 and 6, the second survey also represents students having experiences GBL provided by instructors who have had more experience running the games. The effect of more experienced instructors can be a factor that contributes to the students' experiences, but at the same time, there have been games run by new instructors throughout the programs, particularly for GGSSGG.

Table 8 shows that as the student in BFA have been exposed to games as part of their learning activities, they have become less indifferent and more positive to them. While a small proportion report that they do not like the experience, 52,6% report that debriefing has been important for their learning outcomes. The share of students that are not skeptical to the relevance of games-based learning as a method for relating to current issues in the real-world seafood industry is also decreasing.

The main data we have available for analyzing the games are the student evaluation forms from post-game debriefing and course evaluation. In the 2019 course-evaluation from the cohort that completed the course using the instruction loop described in figure 4 we got anonymous responses from 14 of the 16 students. The students generally report that they are positive to the use of GBL, and that the games have contributed to their understanding of the concept of the tragedy of the commons and the process of fisheries management. In general, the students also report that the games provide practical examples that are useful for understanding the curriculum, as well as fostering discussions between the students. Several responses point out that GGSSG is well suited to illustrate the trouble with pleasing many different stakeholders. Only one response states they did not find the games to be relevant for learning or understanding the games. Further analysis of the qualitative data and depth interviews with students will be performed in the fall of 2019, and the results will be included in the updated paper.

Concluding remarks

This conference paper outlines the models and design for game-based learning in the bachelor of fisheries and aquaculture science at the Norwegian College of Fishery Science at UiT The Arctic University of Norway. Though the use of student active learning that applies constructive alignment, the aim is to provide graduates with the interdisciplinary skills, competences and knowledge that is in demand in the seafood industry, while also facilitating the development of important skills such as critical thinking, problem solving, communication and decision making.

While the data collection for evaluating these efforts are in the initial stage, the baseline for analyzing the outcome is in place. There is still unanalyzed qualitative data from the debriefing sessions of the games to include, which are directly relevant for the evaluation of the use of the games. First survey from student cohorts that have played the games at different stages in the program will be collected in spring 2019. These respondents will have completed the loop design described on page 5. The paper presentation at the conference will present a stronger analysis of the game-based learning efforts in the BFA program.

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