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Challenges in Food-Based Education: Exploring the Potential of Solitons using Virtual Reality Technology

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Abstract

Food-based education is currently under-represented in schools and this is troubling with the high rate of obesity in New Zealand: nearly 30 percent of adults are listed as obese. This study discusses the results of a series of interviews with specialist food teachers and a case study completed at a Christchurch secondary school revealing limitations on food education delivery. A key issue identified in the research is a lack of time, with limited opportunities for practical cooking lessons revealed. Potential solutions are discussed including the use of Virtual Reality technology and gaming, supporting contemporary teaching and learning methods such as the flipped classroom.

Key words

Virtual Reality, New Zealand Food Education, Technology

Background

Cooking Literacy

As a result of changing lifestyles in the twenty first century adults are increasingly more drawn towards convenient, fast and often processed foods (Shahri, 2014), and according to the Organisation for Economic Co-operation and Development (OECD) the same can be said of children and adolescents (OECD, 2017). In addition to this, if the only food consumed in the house is convenience or packet food, children are not getting the vital modelling of effective food preparation that will allow them to cook in the future. Jamie Oliver, a well-known advocate for fresh, home-cooked foods for school students, highlights this point saying:

> I wouldn't say that processed food, ready meals and even takeaways aren't relevant to modern life, it's just that over the past 40 years there are three generations of people who have come out of school and gone through their home life without ever being shown how to cook properly. (BBC—Derby, 2008)

Whilst the OECD obesity report (OECD, 2017) claims 30 percent of New Zealand adults are obese (the same rate applies to children (Gorton, 2016)), the effects of a food-illiterate society are more widespread. Steel (2011) asserts that:

> people who don't cook don't use local food shops, invite their friends around for dinner, know where food comes from, realise what they're putting into their bodies, understand the impact of their diet on the planet, or educate their children in any of the above. (p. 164)

New Zealand nutrition advisor Delvina Gorton highlights the decline in cooking skills, claiming "our children and young people are growing up knowing little more than how to cook toast or turn on the microwave" (p. 1). She also posits that children who cook their own meals will eat 76 percent more salad than those who eat a meal prepared by a parent (Gorton, 2016). The wider effects of not learning to cook, described by Steel (2011), are concerning, and whilst there is a lack of research into the effects that cooking skills have on eating habits, it is clear that it is much harder to eat healthily without them.

Food in Schools

In the *New Zealand Curriculum* (Ministry of Education, 2007), the guiding document for all English-medium, state and state-integrated schools in New Zealand, there are only minimal references to cooking, or foods-related education in the different learning area statements. Specific references only exist within the health and physical education and technology areas of the curriculum. "It is expected that all students will have opportunities to learn practical cooking skills by the end of year 8" (Ministry of Education, 2007, p. 22). This statement gives some priority to food education in the curriculum; however, the curriculum does not prescribe how much time should be allocated, or what types of cooking should be undertaken. In addition to the lack of coverage in the curriculum statement, a lack of suitable cooking facilities and skilled teachers is also impeding the delivery of practical food lessons. Traditional primary classrooms have no kitchen facilities, and while the new Innovative Learning Environments (ILEs), as shown in Figure 1, allow some provision of practical cooking, having only a single stove they do not cater well to large numbers of students.

Figure 1- Te Waka Unua School, (www.tewaka.school.nz**).**

The Garden to Table initiative (Garden to Table, 2019) provides an opportunity for schools to empower students to eat natural foods through planting, tending, harvesting, preparing and cooking foods straight from school gardens. However, too often this opportunity is not used, and most of the produce is taken home directly in its raw form without students having the opportunity to learn how to cook it (Collins et al., 2015). A result, we believe, that is due to the lack of kitchen space, teachers and resources in schools. Sadly, intermediate and secondary schools also suffer from the lack of space, with large numbers of students allocated to too few specialist kitchens.

The majority of practical cooking in schools is covered at Years 7 and 8 when most students attend compulsory specialist subject teaching, including food classes. For most of these students, this equates to around 15 to 20 hours of cooking education per year. This same compulsory learning is not necessarily happening at secondary schools where only a small and declining number of students is enrolled in food subjects.

Table 1: Students enrolled in food education classes in secondary schools 2004-2017.

	Subject		Student numbers		
Year	Food Technology	Home Economics	Total	Overall Total	% in Foods Subjects
2004	31,207	15,693	46,900	273,663	17.1%
2017	32,149	6,326	38,475	284,327	13.5%

Source: (Ministry of Education, 2018a, b, c)

Table 1 shows the number of students enrolled in food-based subjects at secondary schools, with a drop from 17.1 percent in 2004 to 13.5 percent in 2017. The drop has occurred in the area of Home Economics and there are a number of potential issues that could have caused this including the reducing role of the stay-at-home parent, meaning the ability to run the family kitchen is no longer given priority as a learning need. In addition, Dixon (2016) highlights how the representation of Home Economics within the *New Zealand Curriculum* (Ministry of Education, 2007) diminishes its value because whilst "positioned within Health and Physical Education, Home Economics is less visible than Health and Physical Education in the learning area by virtue of not featuring in the title of the learning area" (Dixon, 2016, p. 96). Reviews of food-based education in the UK demonstrate similar challenges. Celebrities, private sectors and third parties as well as the government are involved to change the situation (Earl, 2018).

In the following sections, we describe a study on food education, using a series of interviews and a case study. In order to establish how technology could enhance food-based education practices, we needed to learn the issues teachers are facing and identify the essential cooking skills students need to learn.

The research questions of the study were:

1. What are the most important skills students need in a food-based classroom?
2. What interventions would be appropriate to help teach these skills?

The goal of this research was to establish potential areas within food education that could be developed through the use of immersive technology.

Research Methods

In response to the exploratory nature of the research questions, a qualitative approach was undertaken. Interviews and a case study were carried out between September and November 2018 in Christchurch.

We chose interview as a research tool because the conversation and stories that emerge can give a much clearer picture than a survey (Markopoulos et al., 2008). The interview process allowed us to not only listen to what was being said, but also to read between the lines and probe as required to allow deeper responses to emerge.

We chose case study for the second part of this project because it allowed more in-depth research and enabled the use of a "number of methods and analytical frames" (Thomas & Myers, 2017, p. 2). Whilst we were looking to reinforce the findings of the interviews, a key focus of the case study was research question two, identifying suitable interventions that could be used to teach the skills and attributes identified in the interviews.

Interview

Face-to-face, and semi-structured interviews were conducted with specialist food teachers in Christchurch during September 2018. A local technology accredited facilitator was approached to identify interview participants with recent experience in teaching students at Year 7 to 10 level. Six teachers from different schools were emailed and asked if they would be willing to be interviewed.

Four teachers agreed; all were experienced classroom teachers who had recent experience teaching intermediate or secondary aged students. The interviews focused on identifying the key skills students needed to learn, and establishing the common issues technology teachers face.

An interview protocol (see Appendix A) was prepared to guide the questions and flow of the interview process. Throughout the interviews, the researcher chose to use notes sparingly because note-taking can prevent the interviewer from hearing the full story and cause the participant to wonder what is being written (Josselson, 2013). Instead, an audio recording of the interviews was made. Full transcripts were developed, and these were consequently read through two times, making notes and highlighting key words and phrases. After a short break the transcripts were re-read and the specific student skills and attributes, as well as the teaching strategies and limitations, were identified and colour coded. Themes were identified from clusters of similar responses across the four participants. The results were then collated and summarised.

Case Study

Following the results of the interviews, a case study was completed at Middleton Grange School (MGS) over a period of three weeks from 23 October to 9 November 2018. Three secondary schools with close proximity to the university were approached but after initial discussions, only MGS was able to provide access to specialist foods classes in the middle school area. MGS is a state integrated, Christian, coeducational school with students from Years 1–13. This was beneficial as it allowed us to see how food education was delivered across all school ages.

We used data gathered from a range of sources, including observation of foods classes, observation of Year 7 and 8 homeroom classes, informal discussions with staff, school information scanning, classroom planning, a student focus group and a teacher focus group.

Observation was one of the key approaches used and whilst observation might seem easy, it is highly fallible (Gillham, 2010). Gillam identifies two key areas of fallibility: firstly, as a visitor in the school, an observer inherently upsets the normal balance of the environment; and secondly, the researcher brings a certain amount of predetermined bias in what they expected to, or wanted to see. One key to ensuring accuracy is taking notes as close to the event as possible. For the duration of the time at MGS, a research journal was kept and records were made of discussions, observations of classes, and questions and ideas that arose. At the end of each day, findings were typed into a digital research journal and further notes added as the researcher reflected on what had been observed.

Using complementary methods in the focus groups, the researcher eased the participants into the topic, in order to make them more open to sharing, and to allow more time for recalling of memories (Krueger, 2006). This included providing food and drink, and allowing participants time to mingle prior to starting. Peterson and Barron (2007) claim that when participants are asked to write their own ideas down, there is a greater feeling of involvement, and it is more likely shy participants will contribute. For this reason a range of stimulus material was used to prompt thinking (Barbour, 2011), including a sticky-note activity (Peterson & Barron, 2007) that asked participating students and teachers to identify the enablers and limitations on learning at MGS. An anecdote circle method (Ramlo, 2017) was used later in the student focus group, in which students were asked to describe a time when learning was really fun and to attempt to explain why it was special. Topic guides were prepared to guide the questioning in the focus group sessions (see Appendix B).

The research journal and the focus group transcripts were developed and read through a number of times, highlighting key words and phrases, and making notes. The focus group data was analysed and, in particular, the sticky note activities were used to provide evidence as to what assisted or restricted learning at MGS. The photographs, work samples and teacher planning were also used to recall important information gathered. The key data were analysed, compared with the interview findings, and collated into the key findings presented below.

Findings

Nutrition

A prominent theme that emerged was that the teachers' focus was not on teaching food-based skills, but rather on developing students who can understand the effects of nutrition, can work safely in a kitchen, and can contribute to family meals. All participants, at some stage, mentioned nutrition as their goal:

> … that they feel good about what they are eating and that they can see the practical applications; that they don't have headaches in the afternoon because they haven't drunk enough; that they are not being told off because they haven't eaten enough in the morning, and making sure that they are having breakfast and lunch. (Participant 1)

Participant 1 also added:

> if the last time they do food tech is with me, then I've got a big job - to give them as many skills as I can, and a good knowledge about healthy nutrition.

Participant 4 further emphasised the priority given to nutrition:

> When you are dealing with children you need to be giving the children a healthy food message. I can't get myself away from that. I can't go into the full design, technology side, I am still a bit traditional and teach food and health and nutrition.

The focus on nutrition was highlighted at MGS through the recipes the students were cooking and the projects highlighted on the walls. These projects included a nutrition study of fruits and vegetables, healthy snacks, and models of fruit and vegetable shops.

Health and Safety

Health and safety was the second most prevalent theme with particular emphasis on food safety. Some of the interviewees mentioned codes of practice, basic food hygiene, high risk and low-risk foods, cutting skills, and oven and stove top safety. Participant 3 highlighted the importance of hygiene, stating that students:

> need to have a really good grasp on hygiene, because we obviously need to keep them safe. Including, we want their food to be safe, so we look very carefully at that.

Participant 2 gave more specifics, saying:

> knowledge of food safety is a big one, whether that is critical food control, cross-contamination or food storage.

Health and safety was also obvious in the case study and clearly part of the core routines taught at the start of the year—chopping boards, dish washing, bench preparation and cleaning, aprons and hair care. These pre-taught skills allowed the teacher at MGS to provide student-directed practical lessons where the students predominantly worked with minimal support to complete the cooking. The use of strong routines was something mentioned by all teachers in the study and one of the necessary teaching strategies to complete the entire cooking process within the lessons. Alongside these routines, demonstration was highlighted as the key method of teaching, although this was rarely seen at MGS due to the time of year and the short lesson times.

Cooking Real Meals

In addition to teaching nutrition and food safety, cooking real meals was a recurring theme echoed by Participant 3 who wanted students to be able to "go home and contribute to family meals." Time constraints, however, make it challenging for students to prepare a full meal within classes as short as 50 minutes. Some teachers try to overcome this challenge by teaching the preparation of the meal in parts and then combining them into a one-off event at the end of the term. Others focus on manageable meals and snacks that are achievable in a limited class time.

A clear strength of the middle-school food programme at MGS was its authenticity. As well as cooking real meals, students were asked to cook for real-life clients including sharing a portion of their cooking with a local charity. The teacher made efforts to make this authentic by ensuring she gave feedback back to the students from the charities, if possibly in the form of a thank you letter. At Years 7 and 8, one of the projects was a home cook, where the teacher required students to prepare and plan a celebration meal including entertainment, table settings, and feedback, this genuine expectation ensured the skills taught in the foods classroom were transferred into the home.

Immersive Technology

Each interview participant was asked how immersive technology could be used to enhance their current programmes, but the participants' level of understanding about the potential of the different types of immersive technologies was limited. Regardless, two ideas proposed stood out, the concepts of having food expert speakers who presented in virtual reality (Participant 3) and the ability for students to watch the food process from paddock to table through a virtual medium (Participant 4). All the participants mentioned wanting to use videos in the classroom, both as a whole class teaching tool and as a way of allowing students to catch up on lessons they may have missed, but cited the lack of time to prepare quality resources as a constraint.

In the teacher focus group, teachers discussed a number of digital tools currently used in other classes at MGS, including the use of Kahoot (Kahoot!, n.d.), Education Perfect (Education Perfect, 2019) and NZ maths (New Zealand Ministry of Education, n.d.). These tools showed the capability of the students to use digital tools in their programmes. When looking at what enabled students to learn, the majority of the teachers' responses could be categorised as programme, teacher, and relationships. The key thinking from the programmes' section was providing differentiated tasks and real-life problem-solving activities that require hands-on learning. This was also highlighted as important by the students, whose anecdotes all focused on learning experiences where they had been involved in making something. The teachers in the focus group agreed that the area that had the most effect on student learning was relationships, another point confirmed by the students. One classroom teacher mentioned that they were using flipped learning in their programmes, suggesting a potential solution to the time constraints in the foods programme.

Lack of time

When reporting on the limitations affecting student success in food-based subjects, a lack of time was clearly an issue. This lack of time was evident in two ways: the time in lessons and the time spent with the students overall. With lessons ranging from 50 to 90 minutes, teachers experience considerable time pressure. Unlike other curriculum areas, or even other technology areas, students cannot just pack up their work and return to it the next week. In food classes, they need to prepare, cook, clean-up and sometimes eat food within a short timeframe, meaning “foods is a pressure point” (Participant 3). Hand-in-hand with the issue of time pressure was the lack of dedicated food classrooms. One kitchen for over 650 students in an intermediate school does not allow for long periods of practical cooking. This was shown in the results where the maximum contact time at Years 7 and 8 was 20 hours a year. In secondary schools, the amount of practical lesson time was further restricted due to the lack of available kitchen space.

This lack of time was emphasized at MGS where additional to the issues discussed above, the problem of sharing a food-based classroom with other teachers emerged. Teachers who also taught in other areas of the school had a very short amount of time between classes to move to another area and effectively set up and teach a practical food-based lesson. The Year 7 and 8 students in the case study received only one compulsory 13 week rotation of food education over the two years, which included one theory and one practical food-based lesson a week.

One limitation that could affect the success of a potential intervention is an over-commitment to extra-curricular activities after school, causing tiredness and reducing the time available for home learning tasks. Ironically, the teachers mentioned a lack of access to digital devices as a potential limitation; however, this was not something the students raised.

Discussion

The goal of the research was to establish potential areas within food education that could be developed through the use of immersive technology; in this section we discuss gamification and propose two novel solutions to the issues described in the study. This study highlights a lack of time in practical food classrooms as one of the key findings; also all the teachers expressed a desire to use video technology in their programmes.

Gamification

Gamification is trending in education and offers much potential for future class programmes. Bolstad (2018) claims "[e]ducators who take the time to dig deeper into games discover a wealth of ideas and possibilities to enrich their practice" (p.1). Gamification refers to the implementation of gaming elements into everyday activities. Motivating students in a practical cooking lesson is usually not a problem due to the extrinsic nature of food-based outcomes. However, the same cannot be said of theory-based lessons such as nutrition, or that the basic skills include understanding health and safety concerns in the kitchen. Hence, these areas provide an ideal opportunity for gamified options. With the current addictive effects of games such as Fortnite (EpicGames, 2018) on students, it is hard not to ask how we can engage students in our classrooms in the same way. The use of points, challenge, teamwork, quests and student choice are only some of the elements that make gamification compelling for players.

Based on our findings, the following two interventions, which take advantage of immersive technologies, could support food-based programmes and overcome barriers presented by a lack of practical cooking time.

Game Development

With Codes of Practice or food safety lessons being some of the vital learning areas identified by the food teachers, an ideal solution would be the development of a game that allows students to learn this critical knowledge. This could be in the form of a simulation game that takes on the challenge of running the school cafeteria following the sacking of the previous chef due to unsafe practices. The students would find and rectify the hazards, earning points as they prepare the kitchen, and then the food within the safety guidelines. To have maximum effect, this could be developed as a resource for distribution and use by all New Zealand food-based teachers, specifically designed to teach universal food safety.

Virtual Reality with 360-Degree Cameras

Virtual reality (VR) appears to be at a tipping point with the decreasing cost of quality VR viewers and the ease of content development. The use of a smartphone with a low-cost VR viewer for less than $20 NZD, or an all-in-one option like the Oculus Go (Oculus Go, n.d.) for less than $350 NZD, make viewing VR content in classrooms realistic. High-quality 360-degree cameras are readily available and it is now possible for teachers to record and deliver 360-degree content to students using online tools like Tour Creator (Tour Creator, n.d.), a Google tool designed to add information to 360-degree content, or ThingLink (ThingLink, n.d.), an online tool that gives teachers the ability to link audio, text and video together. This quote from a student involved in a study on the use of 360-degree video clearly highlights the potential of being immersed into a virtual world:

> When reading, I am easily distracted, but this allowed me to learn and experience it in a way that was hard to distract me so since all my attention was focused I could 'stand in their shoes' more. (cited in Johnson, 2018, p.233)

Further, it is claimed that the use of 360-degree video transforms learning from being an abstract experience into one where participants experience "a sense of immersion/presence in the environment" (Harrington et al., 2018, p.997).

We recommend the development of a VR classroom environment that has student logins and a range of tasks, including viewing of tutorial videos, reading information panels, viewing images and a range of questions and information hunts. This type of classroom could be developed using Unity, a game development platform currently used to "create over half of the world's games" (Unity, 2019), which

is free for teachers to use. The addition of gaming elements like quests, points, competition and team work would enhance this concept further. This environment has the potential to incorporate the ideas suggested by the interview participants, showing the food cycle from paddock to table as well as the inclusion of virtual guest speakers.

In addition, such developments would support flipped classrooms, and allow students to complete learning tasks, or lectures in their own time. Thus, when in class, they would be able to complete more practical activities, maximising in-class learning time. The VR classroom has potential for food-based classes where the time in the kitchen is restricted, and it could offer a way of removing theory lessons from the kitchen, yet effectively delivering vital health and safety lessons. The concerns discussed around the use of out-of-class time could cause problems with this approach. However, if the resources adopted are compelling, they could still entice students to participate. Additionally, the extra time for practical learning gained through flipping the classroom, should also provide motivation for students to use the flipped resources.

Limitations

The size of the interview sample, with four teachers, was small. Whilst it was still inclusive of a range of perspectives and revealed recurring themes, a wider viewpoint could be explored. Within the interview sample and the case study, the knowledge about potential immersive technologies and ways they could be used in food education by participants was limited, and therefore their perspective does not necessarily impact on the recommendations to the degree it could. Whilst the authors have a wide range of academic and professional experience, they are not food education teachers. Also, as this data comes from a master's thesis, the research experience of the lead researcher is, in itself, a potential limitation. The data collection process required direct involvement by a researcher and, regardless of the efforts made to not bias the data, simply by being present the researcher influences the data gathered.

Conclusion

With minimal amounts of time dedicated to practical cooking lessons in schools, one of the greatest opportunities to educate younger New Zealand generations about food is lost and the chance of success in the battle against obesity is reduced. Food literacy needs to become a greater priority, and this should come firstly from the Ministry of Education with changes to the *New Zealand Curriculum* (Ministry of Education, 2007). Whilst the intent of this document is to allow schools to develop their own curriculum, some areas like cooking and healthy eating are too important not to be more clearly prescribed (Earl, 2018).

Unfortunately, changes to the curriculum alone will not be enough. In order to achieve more practical cooking lessons, other issues, such as a lack of cooking facilities in schools and an increasing lack of specialist cooking teachers, come into play. Currently, the majority of compulsory food-based education comes into schools at Years 7 and 8, but the lack of space limits an increase in class time, with some schools having only one kitchen for more than 650 students.

Increasing cooking facilities is, however, expensive and unlikely to happen quickly. Therefore, we have proposed two potential interventions that could deliver health and safety content, cooking demonstrations, and a range of other gamified learning tasks outside of practical lessons or via a flipped learning approach, thereby maximising the amount of practical cooking time available to students. The development of a game that specifically targets the health and safety components, or a virtual reality resource that allows students to be immersed into a virtual kitchen, both offer potentially effective, novel, and engaging modes of delivery. More research is needed into which technological intervention is going to be the most effective; however, our position is that this is urgent and must be given priority.

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Appendix A—Interview Protocol

Project: - Using Immersive Technologies to Support Food Based Education
Time of Interview:
Date:
Place:
Interviewer:
Interviewee:
Position of interviewee:

- Thank you for your time,
- Introduce study - My study is based around the use of immersive technologies to enhance foods based teaching.
- Explain proposed stages of study interviews to gather key skills, case study to explore school and product evaluation
- Revisit information sheet key points - Confidential to me and supervisors, will not identify name or school, securely stored,

- I would like to record this interview and request your permission to do so.
- Do you have any questions about the process before we start?

Give time to read the information sheet and sign form, if required.

1. Please tell me about your job as a foods teacher?
2. Can you give me a bit more detail about the students you teach, for example their age, gender, socio-economic background, cultural make up?
3. What practical cooking skills do you believe a student needs to have to succeed at secondary school?
4. What other skills/attributes will a student need?
5. What are some of the teaching strategies/techniques you use to help them achieve these skills/attributes?
6. Please describe any restrictions or limitations that might prevent the students from gaining these skills/attributes?
7. Obviously you are passionate about your subject. With rapid technological changes, how do you see foods education changing in the future?
8. Can you think of ways immersive technologies could be used to enhance your programmes?
9. Have you had any experience with full immersive technology like VR, [Show a headset] partial immersion like Augmented Reality (AR) apps that allow you to look through your phone and see things overlaid on the screen, or Simulation games, games where you perform tasks that simulate the real world?
10. Give brief explanation of VR/AR, show headset / AR, (Google Translate / Pokemon GO) Can you think of ways that these sorts of technologies could be used to enhance your foods programmes?
11. What do you think would be the limitations on using immersive computer-based technologies at your school?

Thank you for taking the time to meet with me and share your thoughts on food education.

Appendix B—Focus Group Questions

Student Focus Topic Guide

1. What is your favourite subject at school? Why?
2. *(Sticky Note activity)* Think about your time at school, what were some of the things that have helped you to learn and also some things that prevent you from learning? Write each idea onto a separate sticky note. When you run out of ideas, add your notes to the poster under the appropriate heading.
   Things that help me learn - things that don't.
3. How are your teachers using technology in your classrooms?
4. If you think about your food lessons, how could technology be used to make them better?
5. Can you think of a time when you really loved being at school? What made it special?

Teacher Focus Group Questions

1. Can you explain to me why you choose to work at Middleton Grange School?
2. *(Sticky Note activity)* If you think about the students at MGS, what do you believe are the things that help them learn and potential limitations on their learning? Put all the ideas down onto separate sticky notes and when you run out of ideas add them to the board.
3. Now, can you please organise the sticky notes into groups. Feel free to duplicate any that belong in two areas. Add labels to the groups.
4. Can you give examples of how you use technology in your classrooms? What tools / programs have you used with the learners?
5. If you think about food lessons, both the practical and theory lessons, how could technology be used to enhance them?