

PROJECT-BASED LEARNING IN CONSUMER SCIENCES: ENHANCING STUDENTS' RESPONSIBILITY IN LEARNING

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ABSTRACT

This study applied project-based learning (PBL) in Consumer Sciences (CS) with the aim of enhancing student responsibility in learning and contributing to teaching and learning by proposing a theory concerning students' responsibilities. First-year students are often overwhelmed when exposed to the challenges of tertiary education as they are required to accept responsibility and direct their own learning processes. To address the problem, this research applied PBL in an introductory CS module to enhance students' responsibility. We propose a theory, which highlights responsibility from the perspectives of self-directed learning, social constructivism and the capability approach. This theory, applying Hegel's notion, emphasises the understanding of individual and collaborative responsibilities where freedom is morally important. To confirm or reject the theory, the investigation explored how first-year students can apply PBL in CS to enhance responsible learning. A mixed method design was used. A population of 104 students participated in this research. Data collection involved a questionnaire, documents, a project and test. The questionnaire was statistically analysed while qualitative analysis involved coding and the emergence of themes. Although some students initially experienced difficulty in managing their responsibilities as part of the CS project, results confirmed the proposed theory and the value thereof in lifelong learning. This theory emphasises the development of responsible independent learners as well as students who are responsible for and dependent on one another to construct knowledge collaboratively within the freedom of choice to achieve well-being.

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INTRODUCTION

First-year university students do not necessarily have the required knowledge and skills to manage their own learning activities. Throughout their time at school, they were mainly exposed to the direct teaching method in a structured, well-defined environment that requires of learners to remember instead of constructing knowledge and managing their own learning (Darling-Hammond, 2012; Slack et al, 2014). As part of the repertoire, students at university need to take responsibility for their own learning, have a high degree of self-efficacy, solve novel problems, cope with complexity, and collaborate strategically with others (O'Connell et al, 2014). Consequently, it is the responsibility of higher-education institutions (HEIs) to provide such a dynamic learning environment and prepare students for responsible lifelong learning and active involvement in the economic workforce.

Responsibility in learning, problem solving and innovation are essential in tertiary education, especially in modules that include a practical component, such as laboratory sessions. Introductory Food is a compulsory and prerequisite module for Consumer Science (CS) and related food sciences at first year level

(North-West University) and covers basic concepts and information of food science, nutrition and food manufacturing. The Introductory Food module therefore challenges students to integrate knowledge of different aspects of foods and pose solutions in various contexts. Nevertheless, first-year students seem to focus on immediate solutions, without developing responsible, independent and collaborative learning.

One of the teaching-learning strategies that may support CS students in this regard is project-based learning (PBL). PBL is a pedagogical practice which goes beyond teacher-centred lessons and emphasises real-world activities where students have the opportunity to work in collaboration and creating innovative and authentic products (Helle et al, 2006; Grant, 2011). To explore the application of PBL in a CS food module, the research question directing this study was: How can first-year students apply project-based learning in a Consumer Science food module to enhance their responsibility in learning?

The remainder of the article is organised as follows: an overview is given of the theoretical framework. This is followed by a report on the empirical research, the results obtained as well as the discussion and conclusion.

THEORETICAL FRAMEWORK

Students experience difficulty in performing academically, especially when they are enrolling for the first time at higher institutions. They are used to the teacher as a provider of subject content who needs to fill the students with knowledge due to the traditional method of learning in schools (Bagheri et al, 2013; Cotterill, 2015). Students find it even harder to construct new knowledge, solve real-life problems, develop innovations and work autonomously (Bagheri et al, 2013; Adejumo et al, 2014). They are mainly driven to pass a course, obtain a degree and get a job. Thus, the emphasis is primarily on what students can 'get' from university rather than focusing on what they can 'give' to the community as responsible life-long learners after studying at such institutions. To encapsulate the challenges involved in learning at HEIs, Consumer Science and project-based learning is outlined in this section. The subsequent sections focus on learning theories and approaches with specific reference to students' responsibility in learning.

Consumer Science

Consumer Science is a dynamic field of study which explores consumer behaviour with the aim of supporting general health and well-being, production and consumption, resource development and sustainability through knowledge, skills and technology (AAFCS, 2001). The outcomes of the Introductory Food module equip students with a broad foundation of specialised knowledge and skills to address food related problems such as food processing, safe handling and hazard control. Students are required to develop deep learning while addressing real-life problems. In addition, Consumer Science students are required to apply knowledge and skills obtained from prerequisite food and nutrition modules in the third year of their programme to develop, for example, new food products by using extrusion technology. Such activities necessitate responsibility, well-rounded knowledge, problem-solving skills, innovation and collaboration to produce a new food product in the end. As a result, these skills should be taught from the first year onwards where students need to build on previous knowledge and experiences that are relevant in the current economic context and support life-long learning.

Project-based learning

Project-based learning (PBL) is an inquiry-based learner-centred approach in response to a complex question, problem or challenge, which enables students to create high-quality, authentic products (Helle et al, 2006). PBL is an innovative and instructional method in which students work mainly collaboratively to solve a real-life problem (Bell, 2010; Grant, 2011). In this sense, PBL goes beyond traditional teaching practices since it addresses real-world issues, fosters critical thinking, promotes deep learning and requires continuous reflection on a task, challenge or problem (Bell, 2010; Rotherham & Willingham, 2010). Furthermore, PBL requires the lecturer's planning, facilitation and support. When implementing PBL, the teacher (lecturer) as facilitator is usually responsible for the planning and design of PBL, whereas the students participate by managing their own learning activities. Students are therefore not simply involved in solving a problem; they are also accountable for their learning activities and their collective contribution to the development of the project or artefact (Havenga, 2015).

With reference to the role of PBL in the domain of Consumer Sciences, a previous study applied PBL in a pre-service teachers' Consumer Studies didactics module where Post-Graduate Certificate in Education (PGCE) students were required to develop projects. Results indicated the fostering of students' responsibility, knowledge and skill development. Participants applied self-discipline, time-management, collaboration and problem solving during project development. PBL enhanced most students' responsibility in planning, designing and developing of a Consumer Studies project (Du Toit, 2015).

Learning theories and approaches

The process of human learning and how it occurs is described by learning theories and approaches in order to guide the planning, instruction, collaboration and assessment of pedagogical activities (Jiang, 2013). This subsection commences by discussing learning theories and approaches, namely social constructivism, the capability approach as well as self-directed learning by focusing on students' responsibility for learning.

Social constructivism According to the constructivists, knowledge is acquired where people are actively involved in creating new meanings and ideas (Üredi, 2014). Constructivism is a theory that involves active and authentic learning, which is student-directed and facilitated by the teacher or lecturer (Jiang, 2013). In particular, social constructivism attempts to understand social phenomena where reality is constructed by students working together in small groups, while sharing ideas and challenging each other's perspectives (Beckers et al, 2015). Learning gain is therefore a product of collaborative initiatives between the lecturer and learner when scaffolding pedagogy, and between learners themselves where they are responsible for and dependent on one another to construct knowledge collaboratively. The social constructivist theory has been embodied in various teaching-learning skills and strategies such as inquiry training, problem-based learning and reflective practice (Bagheri et al, 2013; Jiang, 2013; Beckers et al, 2015).

The capability approach The capability 'to be' is characterised by normative claims that freedom is important to achieve well-being (Lozano et al, 2012; Bessant, 2014). According to O'Connell et al. (2014), 'capability' refers to knowledge, skills, values and self-esteem, which

enable individuals to manage change and be flexible. The nexus of this approach, as outlined by Amartya Sen and Martha Nussbaum (Simon et al, 2013), underpins concepts such as intrinsic value of freedom of choice and equity.

In terms of education, this approach aims to enhance students' capacity and freedom of choice to achieve what they hope to be and what they value as important (Bessant, 2014). With reference to the contribution of the capability approach, Lozano et al. (2012), argue that the approach provides opportunities for developing students' critical and reflective capabilities and enabling them to give meaning to key issues in both their lives and society. Pertaining to teaching and learning, students are expected to make informed choices and address the consequences of their choices. Fraser and Greenhalgh (2001), are of the opinion that learning for capability occurs when students are involved with uncertainty in unfamiliar situations, for example when they are required to solve problems. They assert that capability is enhanced by using, among others, small group, problem-based learning.

As a result, capable students will be more active learners since they are responsible for their own learning, make good judgements and support their self-identity (Bessant, 2014). O'Connell et al (2014), assert that capable people continue to develop knowledge and skills long after they had left formal education – which is one of the characteristics of life-long learning. Furthermore, they argue that 'self-directed learning occurs with capable people' by providing opportunities to adapt to change, generate new knowledge and enhance their performance as part of professional development (O'Connell et al, 2014:2733).

Self-directed learning One of the practices that focus on students' active role and responsibility in their own learning is self-directed learning (SDL) (Knowles, 1975; Havenga, 2015). SDL as a developmental imperative involves individuals taking responsibility for their own learning needs, articulating specific learning goals, implementing appropriate learning strategies and assessing their learning outcomes (Knowles, 1975; Choi et al, 2014). Fisher et al. (2001) argue that the amount of responsibility that an individual is willing to take regarding his or her own learning defines his or her self-directedness. SDL is seen as a means to achieve specific objectives where perseverance is high regardless of some

obstacles or challenges that learners may experience (Ahmad & Majid, 2014). Consequently, students need to drive their own learning and innovation and expect more of themselves.

Self-directed learners are passionate about their own learning, they invest in challenging learning activities, are curious, enjoy solving real-life problems and take part in self-monitoring experiences (Merriam et al, 2007; Adejumo et al, 2014). Applying self-directed learning thus provides a *modus operandi* for managing and constructing organised units of knowledge with confidence in sometimes challenging learning contexts. SDL is therefore a worthwhile experience that fosters the development of responsible independent life-long learners (Pilling-Cormick & Garrison, 2007; Bell, 2010).

Integration of approaches towards a theory of student enablement

Since self-management and acceptance of responsibility are part of the learning process that determines students' academic success, we propose an enabling framework (Figure 1), based on the Hegelian theory (thesis, antitheses, synthesis) (Woods, 2012), to emphasise substantive ground for understanding individual and collaborative responsibilities within normative claims that freedom is morally important, as mentioned by Bessant (2014).

Hegel asserts that a higher level of understanding could be achieved by referring to two different views of a given situation or problem (thesis and antithesis) and integrating these views by forming a synthesis (Woods, 2012). Figure 1 encapsulates three dimensions that influence responsibility in learning, as an integration of the mentioned approaches in an

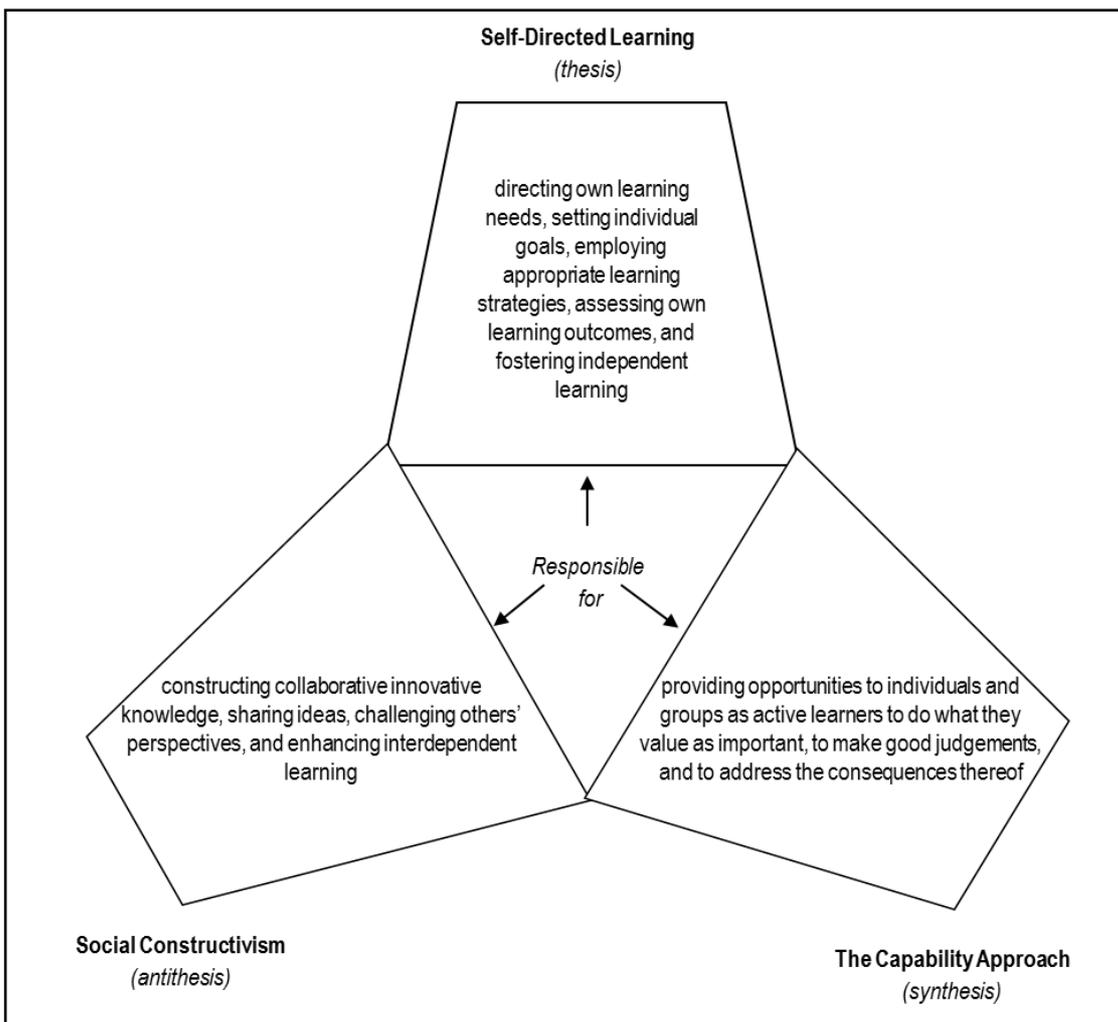


FIGURE 1: THREE DIMENSIONS THAT AFFECT RESPONSIBILITY IN LEARNING - TOWARDS A THEORY OF STUDENT ENABLEMENT IN HIGHER EDUCATION

overarching theory, namely from the perspectives of self-directed learning, social constructivism and the capability approach.

Firstly, self-directed learning emphasises the development of responsible independent individual thinkers and learners who direct their own learning processes (Bell, 2010), which is the thesis showing at the top in Figure 1. Secondly, on the left, social constructivism is an approach that focuses specifically on the collaborative construction of knowledge where students share ideas, challenges and benefits to address a problem of inquiry (Beckers et al, 2015). Social constructivism represents the antithesis as a counter-argument. It seems that there is tension between SDL (with the emphasis on the individual responsibility in learning) and social constructivism (with the focus on the group responsibility for collaborative knowledge construction).

Thirdly, on the right, the capability approach forms the synthesis in the argument. It provides an integrated way of involving both individual and collaborative responsibilities as part of the learning experience where freedom is important to achieve well-being in terms of providing opportunities to do what students value as important, to be responsible, decide on their own learning and make good judgements, as mentioned by Bessant (2014).

To confirm or reject the overarching enablement theory (Figure 1), the aim of the current investigation was to explore how first-year students can apply PBL in a CS food module to enhance their responsibility in learning. The next section reports on the empirical investigation that was based on the conceptual-theoretical framework.

EMPIRICAL RESEARCH

Research design and methodology

A mixed method research approach was followed. This involved quantitative data obtained from a questionnaire and class test based on the content of the project to indicate students' performances, while the qualitative component aimed to give a better understanding of Consumer Science students' responsibility and experiences in a PBL task. With reference to the overarching theory, students completed a self-directed learning questionnaire (quantitative method) as well as weekly project sheets and reflective narratives (qualitative methods) regarding their responsibilities and capabilities in learning. The research involved a pre-test, an intervention and a post-test (Table 1).

Study population and ethical considerations

The population involved first-year BSc students (N=104) enrolled in the Introductory CS Food

TABLE 1: THE RESEARCH DESIGN USED IN THIS STUDY

Pre-test (Individually completed)	Intervention (Team completion) 4 weeks	Post-test (Individually completed)
Williamson's questionnaire: self-rating scale of self-directed learning	<ol style="list-style-type: none"> 1) Plan the project by including team completion of a detailed time schedule 2) Submit weekly project sheets electronically to indicate their responsibilities, progress of design and development 3) Develop a project: research pamphlet on food processing techniques and a poster presenting key aspects from the pamphlet as part of the deliverables 4) Students' narrative reflections regarding their responsibilities and experiences in PBL 5) Formal <i>individual</i> theory test based on the objectives of the project 	Williamson's questionnaire: self-rating scale of self-directed learning

module at a South African university comprising mainly female students. All the students in this module voluntarily participated, and written consent was obtained. Student confidentiality was ensured. This research formed part of a larger SDL research project for which ethical approval was obtained from the university under whose auspices the study was done.

Pre-test and post-test

Williamson's self-rating scale of self-directed learning (SRSSDL) was used, and participating students completed the questionnaire individually as part of a pre-test and post-test (Williamson, 2007). The SRSSDL comprises 60 items categorised under five distinctive areas of self-directed learning, namely Awareness, Learning strategies, Learning activities, Evaluation and Interpersonal skills. Responses for each item were rated by using a five-point scale.

Intervention

A timeframe of four weeks was allocated for project development, and the project was done outside of class time. Prior to project development, the lecturer provided students with detailed requirements and details of the intended assessment of the project. Participants worked in pairs on the project and selected the peers themselves. Initially, the participants completed a time schedule as a group by indicating their project planning, design, development and finalisation of the CS project.

Moreover, the students completed weekly project sheets to specify their responsibility in terms of individual and group contributions towards project development as well as in terms of addressing their planning, progress, challenges and reflections. They also mentioned their roles, interaction and access to resources. Participants needed to submit the weekly project sheets electronically on time since electronic locks were set in the students' learning environment for each week. Students submitted four project sheets in total. As part of the project, the group members were required to search for information, integrate their knowledge, and develop a pamphlet regarding principles of food processing techniques and preservation and signs of food deterioration with reference to following five categories: heat and cold as well as dehydration, irradiation and chemical processing of food. They were required to synthesise and organise relevant knowledge, structure a pamphlet, compile an informative

poster and reflect on their experiences during project development. After the project had been completed, students were required to write an individual test, based on the knowledge and skills they had obtained during project development.

Data collection

Data collection (Table 1) comprised completion of Williamson's questionnaire (SRSSDL), a time schedule, weekly project sheets, development of a food processing pamphlet, narrative written reflections regarding students' responsibilities and PBL experiences, and an individual test after the intervention. The purpose of the documents was firstly to support project development and secondly to determine students' responsibilities and collaboration during the development of the CS project.

Quantitative data analysis

Using the following scoring range and associated levels of self-directed learning, students were divided into Low, Moderate or High self-directed learning levels as follows: 60-140 as low (L), 141-220 as moderate (M), and 221-300 as high (H) (Williamson, 2007). Statistical and practical significance were determined. Statistical significance may yield small p-values as the size of the data sets increase. When using the measure of practical significance, the effect size is independent of the sample size. Consequently, practical significance refers to a 'large enough effect to be important in practice' and is described for different means (Ellis & Steyn, 2003:51).

Qualitative data analysis

All the students completed qualitative documents since these were part of the project requirements. Qualitative data were manually coded and various themes emerged. Differences among the groups and re-occurring themes and concepts were identified and agreed upon by the researchers.

RESULTS

Both quantitative and qualitative results are outlined in this section.

Quantitative results

Although 104 students enrolled for the Introductory CS Food course, only 72 students (69.2%) completed both Williamson's pre-test

TABLE 2: NUMBER OF PARTICIPANTS IN A SPECIFIC GROUP IN THE PRE- AND POST-TEST

		Post-test		
		Moderate	High	Total
Pre-test	Moderate	23	7	30
	High	9	33	42
	Total	32	40	72

TABLE 3: DEPENDENT T-TESTS AND PRACTICAL SIGNIFICANCE: MODERATE GROUP

Item	Pre-test		Post-test		Significance (p)	Effect size (r)
	Mean 1	SD 1	Mean 2	SD 2	2-tailed	
Awareness	3,66	0,33	3,61	0,42	0,53	0,18
Learning strategies	3,33	0,34	3,40	0,42	0,14	0,22
Learning activities	3,36	0,35	3,30	0,44	0,38	0,18
Evaluation	3,29	0,35	3,31	0,58	0,81	0,05
Interpersonal skills	3,62	0,32	3,62	0,37	0,98	0,01

TABLE 4: DEPENDENT T-TESTS AND PRACTICAL SIGNIFICANCE: HIGH GROUP

Item	Pre-test		Post-test		Significance (p)	Effect size (r)
	Mean 1	SD 1	Mean 2	SD 2	2-tailed	
Awareness	4,13	0,29	4,06	0,37	0,24	0,25
Learning strategies	3,90	0,31	3,81	0,40	0,18	0,29
Learning activities	3,92	0,33	3,80	0,47	0,03	0,37*
Evaluation	4,09	0,31	3,95	0,49	0,05	0,47*
Interpersonal skills	4,07	0,30	4,08	0,43	0,85	0,04

Practical significance: * Medium effect size (0,5); ** large effect size (0,8)

and post-test (the project was compulsory as part of the module; however, it was not compulsory to complete Williamson's questionnaire). According to students' answers on the five point Likert scale used for 60 questions, they were divided into three distinctive groups regarding their self-directedness, namely Low, Moderate and High, as specified in the Williamson's instrument. The results were obtained from the Moderate and High groups since there were no participants in the Low group.

Although there were initially 30 participants in the Moderate group, seven moved to the High group after completing the post-test (Table 2). This indicated that these students improved on their self-directed learning skills after the intervention. Nine participants in the High group moved to the Moderate group after the post-test. Participating students in the High group found that they were not as self-directed as initially thought (see Discussion).

The average of the Moderate group increased in the post-test in the following items only:

Learning strategies (3.33 to 3.40) and Evaluation (3.29 to 3.31) (Table 3). As displayed in Table 4, the average of the High group had decreased in the post-test in all except the Interpersonal skills item. The effect sizes had practical significance in the case of medium sizes only for the items Learning activities and Evaluation (Ellis & Steyn, 2003).

Both the project and test were assessed. The test covered the knowledge obtained from the project. The class average for the project was 65.8% while the class average for the test was an unsatisfactory 45.5%. Note that, although participants worked in groups of two on the project, the test assessment was done individually.

Qualitative results

The following main themes emerged from this research: Theme 1: Time Management, Theme 2: Responsibility and Interaction, and Theme 3: Students' Capabilities and Well-being.

Theme 1: Time Management

Students were required to manage their time due to various obligations. Some examples are included: 'The search for information was postponed because we had other obligations for other assignments' (Group 31 (G31)); '... lacking time management because of an overloaded schedule' (G17, G18); 'many hostel and sport activities were responsible for us falling behind schedule' (G41); 'the time table was rescheduled; we did not have the same times off ...' (G1, G35).

Theme 2: Responsibility and Interaction

With reference to responsibility, the majority of groups indicated that they divided the work among themselves, work individually and shared information during scheduled meetings. '[We] worked separately and then discussed it together' (G3); '[we] worked during the weekends to catch-up on work' (G24, G25); '[We] used the library's facilities and resources to complete the assignment' (G27). Interaction and communication were sometimes a problem. 'We had problems within the group and did not communicate properly because we were all busy' (G3); 'we had planned to work together but it was miss-communicated that one of the members had a problem' (G1).

Theme 3: Students' Capabilities and Well-being

This theme involved excerpts of students' decisions about their own learning, capabilities, well-being, values and freedom, or a lack thereof. 'We worked in our own time on the task and supported one another. Each [student] was responsible for a section with which she was comfortable' (G43). 'We encouraged one another' (G25). '[We] supported and motivated each other' (G46); 'stay committed to scheduled appointments' (G34); 'learned about additives ... this enabled me to make better food-related decisions' (G51). 'Our interaction was excellent ... both were positive about the task. We achieved our aims' (G27). 'We became very good friends' (G50). Some problematic experiences regarding well-being included the following: 'I could not locate a group member' (G7); 'my group member was admitted to hospital' (G12).

DISCUSSION

An integrated discussion is outlined in this section to answer the research question: How can first-year students apply project-based learning in a Consumer Science food module to enhance their responsibility in learning? The

discussion of findings is followed by the alignment of the conceptual theoretical framework with examples of students' feedback that emerged from this study and the implications thereof.

Discussion of the findings

With reference to Williamson's self-rating scale of self-directed learning (SRSSDL) (Williamson, 2007), of the 30 participants initially in the Moderate group (pre-test), seven moved to the High group after completing the post-test (Table 2). In the post-test, the average of the Moderate group increased in two items, namely Learning strategies and Evaluation (Table 3). It seems that seven students in the Moderate group enhanced their self-directed learning as a result of the project-based learning experience. Regarding the High group, nine participants moved to the Moderate group after the post-test. Moreover, the average of the High group decreased in the post-test and only the results pertaining to the items Learning activities (0,37) and Evaluation (0,47) were practically significant (medium effect size) (Table 4). Participating students in the High group found that they were not as self-directed as initially thought. After participating in PBL activities, these students had a realistic view of their own responsibility to direct their learning processes. Since CS students also need to develop projects in their second and third year, additional guidance and support should be given particularly to the students who moved from the High to the Moderate group to enhance their self-directed learning.

Although project groups obtained an average of 65.8% for their projects as part of PBL, the formal assessment test, based on individual students' knowledge regarding their projects, was an average of only 45.5%. Since students did not design an information pamphlet using similar topics in all the groups, groups were required to share the content based on the remaining topics with all the students in the cohort during a class session. It is most likely that, although participating students mastered the knowledge based on their own projects, there were probably some gaps in their learning with regard to the remaining topics. Moreover, the unsatisfactory low average score for the class test probably indicated that some participants experienced problems as a group since they needed to work in collaboration and construct the knowledge themselves. 'This week we had to work on group work skills so that we

could communicate better and not make the same mistake' (G3).

Some groups indicated additional challenges regarding their project experiences as emerged in the themes. Students experienced challenges with Time Management (Theme 1) due to various reasons: an overloaded schedule (G17), various tests (G5) as well their involvement in residence activities (G41). To address some of these challenges, group members said they were required to re-schedule their meetings as a result of differences in their weekly timetables (G1). In addition, some group members reported that they learned to prioritise their activities (G31). The last two examples indicate how group members took responsibility and addressed the challenges that they had experienced during project development.

Upon reflection on Theme 2 (Responsibility and Interaction), some positive and negative experiences were obtained. The majority of groups divided the work among themselves, scheduled meetings and worked additional hours to finalise the project. '[We] worked during the weekends to catch-up work' (G24). Most CS students valued group work as an important means to work in collaboration on this project. However, a few students experienced miscommunication in their groups as well as problems to obtain the relevant information.

Regarding Theme 3 (Students' Capabilities and Well-being), some examples are included where students took responsibility for their own decisions and well-being: they were committed to finalise the project and group members were motivated and supportive. Furthermore, members emphasised the importance of group responsibility and values since they 'encouraged one another to work harder and for a longer time' (G25). 'We assisted one another, explained and exchanged all information and worked in collaboration' (G46). The knowledge that students obtained enabled them to make better food-related decisions.

Figure 1 encapsulates three dimensions that influence responsibility in learning, as they emerged from this study, from the perspectives of self-directed learning, social constructivism and the capability approach. Self-directed learning (thesis, Figure 1, top) emphasises the development of responsible independent individual thinkers and learners who direct their own learning processes. With reference to Theme 2, the majority of groups mentioned that

they divided the work among themselves, work separately and shared information during scheduled meetings. '[We] worked apart and then discussed it together' (G3, G10); G1 also outlined their specific responsibilities as an indication of their self-directedness: 'Member 1 evaluated and underlined important information regarding freezing and freeze drying, whereas Member 2 evaluated drying and selected the essential information'. Similarly, Group 28 mentioned, 'Member 1 searched and analysed information about fermentation whereas Member 2 determined and analysed the challenges of food [preservation]'. These are examples of students who took responsibility for their own learning and directed their thinking towards solving the problem of inquiry. This is in line with Merriam et al. (2007), in their contention that SDL students are passionate about their own learning, invest in challenging activities and enjoy solving real-life problems.

PBL provides opportunities for students to construct knowledge in a collaborative way (social constructivism (antithesis, Figure 1, left)). '[We] worked during the weekends to catch-up on work' (G24) (Theme 2). 'Each person had to bring information and we sat and worked together' (G3). 'We critically discussed the information, identified important facts and determined shortcomings that needed to be addressed by using additional resources' (G10). These examples give prominence to students' responsibility as a group, their positive dependence on each other as well as their support to one another.

The capability approach (synthesis, Figure 1, right) provides an integrated way of involving both individual and collaborative responsibilities, which emphasises freedom, well-being and decision-making about students' learning. Nevertheless, students are required to address the consequences of their choices and be responsible for the decisions that they make. Some findings from Theme 3 involve that students 'stayed calm and supported one another' (G50), 'encouraged and motivated each other' (G25, G46); and 'stay committed to scheduled appointments' (G34). Likewise, Bessant (2014:145) argues, 'students would be more active learners, have some say over the content of their learning and pedagogy rather than being recipients of information and teaching practices that others determine they need or ought to value'. As a result, capable students are responsible for deciding about their own learning and making good judgements.

TABLE 5: ALIGNMENT OF THE CONCEPTUAL THEORETICAL FRAMEWORK WITH SOME EXAMPLES AND THE IMPLICATIONS THEREOF

Aspects in the theoretical framework addressed	Examples of students' feedback	Implications
<p>PBL in Consumer Sciences</p> <ol style="list-style-type: none"> <li data-bbox="188 443 560 533">1. Inquiry-based learner-centred approach. Addressing real-life problems. <li data-bbox="188 656 560 745">2. Deeper learning, critical thinking and continuous reflection on a task. <li data-bbox="188 902 560 992">3. Innovation, creating high-quality, authentic products 	<p>'We searched for information regarding food processing, for example dehydration of food' (G7). 'Dehydration is one of the oldest preservative methods ... also the simplest method, it prevents bacterial growth' (G6).</p> <p>'The purpose was to analyse and process the information' (G32). 'Identified important facts and addressed gaps. The information needed to be formulated in a report' (G11). 'We learned that there were various ways to process food, for example vacuum pack, dehydration and canning' (G14).</p> <p>'Each person had to do research, but we came together to rule out information that was the same and narrow all the points down. For every person to have done their parts of the project in order to complete the assignment and finalise everything' (G3). 'Our planning was to discuss and integrate the findings' (G51).</p>	<p>Addressing real-life problems, e.g. food processing and preservative practices, maintaining and supporting food quality, especially in our country with limited resources.</p> <p>Providing opportunities for students by applying higher-order thinking skills such as analysis and synthesis, and compile a report. Students also reflected on the knowledge and skills they obtained.</p> <p>Construction of innovative projects and products, such as an informative food pamphlet and poster, to support knowledge access regarding consumer goods.</p>
<p>Self-Directed Learning (thesis)</p> <ol style="list-style-type: none"> <li data-bbox="188 1205 560 1294">1. Fosters the development of responsible independent life-long learners. <li data-bbox="188 1451 560 1541">2. Achieve specific objectives where perseverance is high regardless of some challenges. <li data-bbox="188 1664 560 1809">3. Invest in challenging learning activities, are curious, enjoy solving real-life problems and take part in self-monitoring experiences. 	<p>'My own aim was to find different information to the rest of the group as well as coming up with different, creative ideas so I could contribute my part to my group. I was given the responsibility to research what effects irradiation has on the food industries as well as on consumers' (G3).</p> <p>'I could not get hold of my team member. I did the framework ... it was difficult for me to address my weekly planning. I worked late in the evenings' (G7). 'I need to do the planning and obtain information since my team member became ill this week' (G14).</p> <p>'This week I need to search for information to enable me to complete the task. I need to make decisions regarding what is important and what is not important' (G11 member).</p>	<p>Each student had to research concepts and basic principles of a specific aspect of food processing. Planning and research form an integral part of life-long learning.</p> <p>Real-life problems involve various challenges. People (students) need to address such challenges to enable them in achieving specific aims.</p> <p>Solving real-life problems is an important skill that learners, students and individuals should apply.</p>
<p>Social Constructivism (anti-thesis)</p> <ol style="list-style-type: none"> <li data-bbox="188 1906 560 1995">1. Knowledge is acquired where people are actively involved in creating new ideas. 	<p>'We assisted one another, explained and exchanged all information and worked in collaboration' (G46).</p>	<p>Collaborative initiatives involve that individuals are dependent on one another for knowledge construction.</p>

TABLE 5: ALIGNMENT OF THE CONCEPTUAL THEORETICAL FRAMEWORK WITH SOME EXAMPLES AND THE IMPLICATIONS THEREOF - Continued

Aspects in the theoretical framework addressed	Examples of students' feedback	Implications
2. Reality is constructed by students working together in small groups, while sharing ideas and challenging each other's perspectives.	'We critically discussed the information, identified important facts and determined shortcomings that needed to be addressed by using additional resources' (G10).	During group meetings, gathered information was evaluated and used to compile the written report. Active involvement throughout the process provided learning through individual study, discussions and construction of the report.
3. Learning gain is therefore a product of collaborative initiatives. Students are responsible for and dependent on one another to construct knowledge collaboratively.	'We are working well together and seem to be accomplishing more through splitting the work' (G17). 'We work in our own time on a task to support each other. Each [member] was responsible for a specific section that she is at ease with' (G43).	Collaborative initiatives resulted in a well-developed report with integrated information and an informative brochure with relevant information communicated to a broad audience.
Capability Approach (synthesis)		
1. Intrinsic value of freedom of choice and equity to achieve well-being.	'Each [student] was responsible for a section with which she was comfortable. We worked in our own time on the task and supported one another' (G43). 'We encouraged one another' (G25). 'We became very good friends. We stayed calm and supported one another' (G50).	In terms of freedom of choice, each student was required to do research about a section with which she felt comfortable. Support and encouragement are important skills to achieve well-being in a social context.
2. Developing students' critical and reflective capabilities give meaning to key issues in life and society.	'We were required to integrate only the appropriate information and display this in a poster. We learned much when developing this project' (G16). 'We make better food-related decisions' (G51).	People in diverse contexts, life and society need to make informed food-related decisions and solve real-life problems.
3. Active learners, responsible for their own learning, make good judgements, support self-identity.	'Any spare time we had as a group was spent together putting our final ideas together for the poster as well as the pamphlet' (G3). 'My aim was to learn more about [food] additives. I aim to give more attention and elaborate on my knowledge regarding products with additives when visiting shops' (G27).	Manage their own learning and recognise own potential and qualities as an individual as well as in a social context, e.g. in a community.
4. Self-directed learning occurs with capable people, adapts to change, generates new knowledge, enhances professional development.	'Get as much information as we could to cover the lost time we had and compile all the work we got together to produce something solid' (G30).	Develop skills to address real-life challenges, adapt to change (e.g. the time lost) and construct new knowledge.
5. Capability is enhanced by using, among others, small groups and project-based learning.	'We aim to obtain information regarding what food processing entails and what is the influence of food processing on consumers and the food industry to enable us compiling a complete report [pamphlet]' (G14). 'Our interaction was excellent ... both were positive about the task. Each [student] was responsible for a section with which she was comfortable' (G43).	All aspects of the assignment supported students' accountability and enabled them to manage their own learning, contextualise hygienic food processing, and prioritise academic and non-academic activities to finally meet all obligations within a given time frame.

Alignment of the conceptual theoretical framework with the findings

As part of a summary, this subsection aligns the conceptual theoretical framework and overarching enabling theory with examples regarding students' responsibility in learning as well as the implications thereof (Table 5).

To consolidate, within the freedom of choice, individual students are required to decide on their own learning and responsibility in a learning task while addressing real-life problems. In addition, group members need to make good judgements and informed choices regarding, for example, project development, and they have to encourage and support one another. It is further important that obtained knowledge should be communicated to communities in a suitable format as part of skills development that is essential for students in these professions. Thus, the findings confirm the proposed overarching enabling theory regarding students' individual and group responsibilities where freedom is morally important.

In terms of the implications for Consumer Science teaching, lecturers need to select appropriate real-life problems (e.g. food-related problems), apply PBL and challenge students to be responsible for solving such problems in collaboration as a reflection of real-life settings in the CS industry. A recommendation is that such knowledge and skills need to be developed from the first year onwards.

CONCLUSION

This research applied project-based learning in an inter-disciplinary field of study at a South African university with the aim to enhance students' responsibility in learning regarding a Consumer Science food module. This was achieved by most of the participants after developing the research pamphlet (project) on food processing techniques. Furthermore, the findings contribute to the theoretical perspectives and conceptual field of teaching and learning by proposing an enablement theory concerning students' responsibilities. A theory of student enablement in tertiary education is proposed that highlights three dimensions of responsibility in learning from the perspectives of self-directed learning, social constructivism and the capability approach. This enabling theory is based on the Hegelian notion - creates a conflict (thesis), creates an opposition to the conflict (antithesis), and offers a solution to the

problem (synthesis) - to emphasise substantive ground for understanding individual and collaborative responsibilities within normative claims. The findings confirm the overarching enabling theory regarding students' individual and group responsibilities where freedom is morally important. A limitation of the study is that participating CS students were not used to project-based learning as a teaching-learning approach and they did not necessarily have the skills to work together in groups. Future research may involve the application of additional strategies such as cooperative learning to enhance effective group work.

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