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Lenses on the post-oil economy: Integrating entrepreneurship into sustainability education through problem-based learning

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Abstract

In the context of enormous global challenges such as climate change, poverty, and the unequal distribution of wealth, sustainability education within higher education has gained momentum as a tool to train a new generation of change agents. In practice, previous research has examined the relationship between sustainability education and entrepreneurship education. Both educational domains share similar teaching and learning frameworks as they both seek to train action-oriented professionals. Yet despite these similarities, there is a knowledge gap regarding course development strategies that can integrate entrepreneurship competencies into sustainability education. Following a classroom action research (AR) approach, we developed a three-week graduate course aimed at an interdisciplinary cohort of students in the social sciences from partner universities in Brazil and Norway. The course integrated a problem-based learning (PBL) framework. As part of the methodology, teachers introduced real-world challenges in the context of a post-extractive economic transition. Working in groups of four to five members, the students provided business solutions framed in a post-oil development context. The results indicate tension points in the integration of the learning principles of PBL along the different phases of PBL, namely during the group formation and problem analysis phases. To tackle these tensions, we propose that this type of course should facilitate early group formation and integrate formative feedback and progressive problem analysis. Our framework contributes to the debate on competence-based frameworks within the sustainability education literature. The framework can also serve as an inspiration for course designers in higher education.

Keywords: sustainability education; entrepreneurship education; problem-based learning; action research; higher education; interdisciplinarity

Word count: 11685

Introduction

The United Nations Environment Program (UNEP) Stockholm Conference in 1972 named universities as key actors in the promotion of sustainable development (Wals 2014). Multiple experiences show that the challenges linked to sustainable development are inherently complex because they require multi-stakeholder solutions and interdisciplinarity, necessitating the adoption of sustainable development principles in day-to-day activities and across study programs (Lozano et al. 2013). In recent years, the literature has focused on the links between sustainability education and entrepreneurship education (Mindt and Rieckmann 2017). A traditional narrative linking entrepreneurship education to sustainability is training students to identify and exploit opportunities that can trigger new businesses, products or commercial services while also tackling sustainability challenges. The literature supporting this narrative defines the relationship between sustainability and entrepreneurship education by highlighting the role entrepreneurs play in developing solutions (product/services) that contribute to sustainable development (Moon 2015; Karlusch, Sachsenhofer, and Reinsberger 2018). In contrast to this traditional narrative, new research tries to develop more over-reaching relationships between sustainability and entrepreneurship education. One such emergent view is competence-based teaching frameworks for sustainability-driven entrepreneurship (Lans, Blok, and Wesselink 2014). The focus of entrepreneurship education is the development of key competences, such as opportunity identification; social, business, and industry-specific competences; and entrepreneurial self-efficacy (Lans, Blok, and Wesselink 2014). Entrepreneurship education programs should evolve to educate sustainability-minded students, highlighting, e.g. new competences such as system-thinking and interdisciplinarity (Mindt and Rieckmann 2017). This requires new ways in which curricula can be enhanced to match

sustainability education within entrepreneurship education (Wyness, Jones, and Klapper 2015). The main issue is where "sustainability" should fit into the curriculum. Sustainability remains a niche topic within the overall entrepreneurial literature. Social entrepreneurship is considered part of sustainability. To tackle this compartmentalized view on sustainability within entrepreneurship education, another emerging perspective calls for the holistic integration of entrepreneurship skills within sustainability education through a teaching framework focused on active-learning approaches, external collaboration, and themes such as innovation-design, entrepreneurship ecosystem support and corporate organizational culture (Hermann and Bossle 2020).

Sustainability challenges are ‘wicked’ problems, which call for ‘off-the-shelf’ solutions (Lans, Blok, and Wesselink 2014). In this regard, problem-based learning (PBL), an active-learning approach, is a good fit with sustainability education because it facilitates a process of problematization, investigation and critical reflection. Throughout this process, students can work towards feasible solutions to the wicked problems under consideration (MacVaugh and Norton 2012). PBL is relevant for entrepreneurship education programs as it creates a learning environment that allows students to tackle real entrepreneurship problems; mirrors learning in the workplace; engages students’ previous knowledge and complements it with emerging interests; and sets a learning arena where collaboration and sharing enhance responsibility (Wee 2004). Extant research identifies some commonalities in programs leading to sustainability and entrepreneurship learning objectives. These commonalities include active-learning and real-world oriented learning approaches, both of which characterize PBL. From a pedagogical point of view, then, PBL has the potential to develop students’ competences to grasp the complexity of sustainability challenges while enhancing creativity grounded in local needs (Mindt and Rieckmann 2017). Despite this

potential, studies lack detail on how to develop a higher education curriculum that applies active learning approaches in a real-world oriented setting. This paper responds to calls for a better understanding of curriculum design that incorporates sustainability and entrepreneurship competence development in multiple disciplines in a higher education setting (Wyness, Jones, and Klapper 2015; Mindt and Rieckmann 2017) and thus tackles the research question: *How is active learning best integrated into a higher education curriculum with entrepreneurship and sustainability learning objectives?*

To answer this question, this article proposes the integration of PBL (Hung 2011). We first conceptualize entrepreneurship and sustainability education, then analyze the key pedagogical characteristics of PBL within this sphere. We then present the results of our work, in which we relied on action research (AR) as the inquiry strategy along the PBL framework in order to design and teach a five-credit course at the masters level in Norway and Brazil. Considering that PBL is not integrated into the partner institutions' routines, AR fits well with the purpose of inspiring institutional reflection at an organizational level (Elo 2016). Classroom action research (Kemmis and McTaggart 2005), in particular, fits well with these objectives as it allows students and teachers to critically analyze their practices for the purpose of improvement.

This research contributes to the emerging literature of sustainability education, which inquires about the integration of sustainability with entrepreneurship by arguing that PBL is an approach where students can disentangle their learning. In practice, teachers in higher education can draw inspiration from the PBL method presented here to create heuristic tools to organize their own courses.

The paper is organized as follows: in the next section, the literature review examines previous research on the use of PBL in entrepreneurship and sustainability education, while the third section presents the materials and methods. The fourth section

summarizes the findings, and it is followed by the discussion, conclusion and suggestions for further research.

Literature review

Problem-based learning as a pedagogical approach

Universities across the world are increasingly adopting PBL in different disciplines. An overview by Kolmos (2013) summarizes different PBL models in engineering, medicine, and architecture, among others, in countries like Australia, Brazil, Malaysia, Denmark, Portugal and the USA. The Journal of Problem Based Learning has also been compiling a variety of teaching experiences across geographies and disciplines since 2013 (Ryberg and Nørgaard 2013). PBL originated in the 1960s in the medical school at McMaster University (Canada). It was influenced by existing pedagogical currents, particularly by Dewey's ideas about intrinsic interest, Bruner's "learning by discovery" and the case-based learning of Harvard Business School (Schmidt 2012).

Initially, PBL integrated a rather rigid methodology that had students work in small groups to examine a problem-scenario and engage in their own learning to identify knowledge gaps (Savin-Baden and Major 2004). This methodology highlights one central component of PBL, which is the relationship between learning and the 'problem'. Some authors widely define a problem as a collection of phenomena and events (Schmidt 2012). A problem is also defined as an unsettled issue that is not necessarily negative but that needs to be resolved (Maudsley 1999), and in that sense it can be considered in relation to students' own knowledge production. Here, the focus is on how the student applies a logical analytical process in order to disentangle the setting of the core problem. What makes PBL special in terms of student learning, in addition to differentiating PBL from other approaches, is the so-called "theory before

application" discussion, or the question of whether pre-existing knowledge is required for a student to meaningfully engage with the approach. PBL does not require a sound theoretical base before application (Maudsley 1999).

The adoption of PBL by different higher education programs goes along with the inclusion of some of the key principles of learning as a constructive process, learning as a self-directed process, and learning as a contextual process (Moust, Berkel, and Schmidt 2005). First, problems are introduced as a stimulus for learning and so learning is constructive, implemented through forms of elaboration including discussion, note taking and answering questions. Second, problems stimulate the students' prior knowledge and help them to engage in the sense-making process with their peers. This requires students to take ownership of the knowledge building process. In order to solve a given problem, students need to plan, monitor, and evaluate their own learning, and learning is therefore self-directed. Lastly, a PBL setting provides context by integrating previous knowledge as a benchmark against which to measure learning goals and by building a social framework in which students collaborate and come to share common goals or responsibilities. PBL settings also provide a context for learning, since one goal of PBL is for students to identify situations in which their new knowledge can be used (Dolmans et al. 2005).

Programs that share these design characteristics tend to have a strong focus on the learner's experience, students who take responsibility for their own learning, a close relationship between theory and practice, interdisciplinarity, a strong focus on the learning process, instructors who act as facilitators rather than experts, and students who are capable of self-assessment (Savin-Baden and Major 2004; Dochy et al. 2003).

Problem-based learning in sustainability education and entrepreneurship education

PBL is increasingly integrated in the teaching of sustainability and entrepreneurship. An argument for this integration is that education in both fields is increasingly training students to be agents of change, to be able to work in teams, and to produce relevant knowledge in context.

The definition of sustainability education is often scoped within the context of the education program, and its goal is framed as the integration of sustainable development principles holistically across educational programs (Leal Filho et al. 2017). PBL and sustainability education promote principles of interdisciplinary and collaborative learning, and both promote a meaningful experience through providing ample context (Guerra 2017). PBL is integrated into sustainability education at the graduate and undergraduate levels. At the undergraduate level, some of the best-known experiences include the program of environmental studies at the University of Arizona that has 82 PBL courses (Wiek et al. 2014). Teaching experiences in accounting education at a university in south-west England used to enhance students' knowledge about sustainability and teamwork (Wyness and Dalton 2018). Engineering programs are offered at Aalborg University in Denmark (Holgaard et al. 2016) and at RMIT University in Australia (Thomas and Depasquale 2016). At the graduate level, Ban et al. (2015) sketch several cases in which PBL is integrated into education for sustainability. The scope of courses inspired by a PBL framework vary. For example, the undergraduate program at the University of Arizona organizes PBL-inspired courses, workshops, student-focused projects with foundations, and PBL-inspired theses (Brundiers and Wiek 2013).

PBL has also been discussed in the literature of entrepreneurship education, and in this way it shifts the conceptualization of entrepreneurship. Entrepreneurship is

commonly understood as the process of starting an organization from scratch (Wee 2004). In relation to this perspective on entrepreneurship, researchers have argued that entrepreneurship education should train students with competences to recognize opportunities that others have overlooked (San Tan and Ng 2006). In this light, entrepreneurship education is increasingly relevant to fulfilling a set of objectives such as developing skills to adapt to change and learn in an ever-changing context. This is achieved through a pedagogy where the learning is partly carried out in collaboration with stakeholders beyond the classroom and through learning by doing, which manifests in internships and new ventures developed during entrepreneurship courses (San Tan and Ng 2006). In entrepreneurship programs, including those that use PBL as a learning approach, problems are structured with the aim of giving students greater freedom to self-direct their knowledge development process. Similarly, problems are authentic, which intensifies learners' inspiration to search for knowledge gaps. Students are thus in close contact with businesses and their problems (Rossano et al. 2016). In entrepreneurship education, the literature primarily discusses PBL's integration at the undergraduate level. In Singapore, Temasek Polytechnic introduced the "Practice of entrepreneurship" course, delivered through the philosophy of "the problem comes first", which entails the problem acting as a catalyst to incentivize further knowledge gathering. The "developing enterprise" course has a curriculum that includes 16 problems divided over the 16-week semester (San Tan and Ng 2006). In a large German university of applied sciences, PBL is integrated into a UBC (University-Business Collaborative) and involves a consultancy project involving both undergraduate and graduate students. Within this UBC, before starting their project in a company, students take learning modules to develop a theoretical base in marketing and management (Rossano et al. 2016). Leeds Business School in the UK has adapted problem-based

learning and project-based learning to develop its own pedagogical approach, termed entrepreneurial voluntary-based learning. The course they run is aimed at enhancing students' understanding of applied ethics in the context of local community businesses (Clarke and Underwood 2011).

How PBL-inspired courses are best conducted for sustainability and entrepreneurship education

Despite already being integrated in a variety of educational programs in different countries, the principles of PBL still inspire the learning process, and we can summarize four general phases in sustainability and entrepreneurship courses: problem design and presentation, group formation and planning, problem solving, and assessment.

During the first stage, problem design and presentation, those responsible for the course often take the time to prepare or set the learning conditions for the relevant problems. Problems are grounded in real-world issues and are to a large degree unstructured. Course organizers need close collaboration with local stakeholders to identify problems with the right characteristics. In such cases, the lecturers are the initial contacts with stakeholders as a result of other ongoing collaborations (Rossano et al. 2016). Problems or challenges can also be inspired by news sites, newspapers, or magazines (San Tan and Ng 2006). In other courses, problem preparation runs in parallel with student training on the pedagogical tenets of PBL, including project management skills (Kolmos et al. 2008). During this initial phase, the facilitator introduces the students to the real-life problem. This allows them to activate previous knowledge but also inspires them to identify knowledge gaps and pursue new objectives (Wee 2004).

During the second stage, groups are organized and a plan is made in terms of the required hours for group activities. Program requirements depend on the institution. In some programs, right after the problem is introduced, the instructor and students hold a first session focusing on problem analysis. The idea is to identify issues about which the students would like to become more knowledgeable (San Tan and Ng 2006). Later planning involves a 35-minute brainstorming meeting where students form teams and complete a PBL worksheet to create a work plan, which they can then discuss with the tutor (Wee 2004). Various institutions suggest different group sizes. In the environmental studies programs at Arizona State University the size of the group varies, from one group/ one project including 2-6 students to larger groups (Brundiers and Wiek 2013). In the engineering program at Aalborg University, PBL is combined with courses at a 50/50 rate, and groups comprise up to eight members (Holgaard et al. 2016).

The third phase is problem-solving. Institutions provide different resources to facilitate group work in such a way that students apply peer learning, teamwork and self-direction in their learning process (Wiek et al. 2014). At Aalborg, each group is provided with resources including group rooms and a supervisor who will tutor them throughout the project (Guerra 2017). Increasingly, IT solutions such as videoconferencing or virtual boards are used as resources in PBL environments. Blended learning is understood here as the combination of face-to-face traditional teaching modules and remote and e-learning tools (Dohn, Thorsen, and Larsen 2015, 305). Blended learning is also adapted to PBL teaching in sustainability programs along with case studies solved partly through e-learning and partly using face-to-face workshops (Coppens et al. 2020). Virtual learning environments and remote supervision are increasingly part of PBL integration in entrepreneurship courses (Clarke and

Underwood 2011). In sustainability programs, much of a group's time is spent analyzing the problem. Hence, students brainstorm possible solution scenarios based on their existing knowledge (Holgaard et al. 2016). By the end of this phase, groups present preliminary findings, clarify gaps in knowledge, and identify potential solutions for the problem (San Tan and Ng 2006).

The final phase is the assessment of the group work. Among researchers and educators who use PBL principles, there is increasing agreement about using formative assessment (Peart, Fairhead, and Stamp 2018; Grob, Holmeier, and Labudde 2017; Kelley et al. 2019). The purpose of the assessment is thus giving feedback and facilitating the students' improvement of their learning during the course, not only at the end of the course. Often it is the tutor who provides feedback throughout the PBL process (Kolmos et al. 2008). In a course on entrepreneurship education, assessment is largely driven by student reflections as opposed to an end project/product (Clarke and Underwood 2011). However, most courses require students to prepare a report. In one course with a focus on water management in communities, a team's final project was to propose an intervention plan that would ultimately help the community face the challenge presented in the study. In one case, real community intervention was inspired by the students' projects (Wiek et al. 2014).

Methodology

Research design

This paper followed an AR approach, which has been applied in similar experiences of competence development such as sustainability education (Jensen 2016) and entrepreneurship education (Winkler 2014; Elo 2016). Adopting an AR approach implies that the researcher takes a participant observer role (Bryman 2012). In

294 educational development projects, AR is often applied following the incremental
295 curricular steps of curricular design, intervention and analysis. Subsequently, the cycle
296 starts again, and once the intervention is analyzed, a new intervention is carried out
297 based on this reflection (Jensen 2016; Elo 2016).

298 In combination with the AR approach, we collected and analyzed empirical
299 materials through qualitative inquiry. The choice of qualitative methods lies in the
300 possibility of engaging the empirical materials with a narrative, and we thus adhere to
301 Denzin and Lincoln's (2018) understanding of qualitative research as a process that
302 begins with the researcher's involvement in the study's setting, i.e. collecting materials,
303 interpreting them, and translating them for the final reader.

304 In this section, we report the context of the study; secondly, we discuss our data
305 collection methods (participant observer, document analysis and interviews); finally, we
306 discuss our choices in the presentation of the results.

307 ***Context for developing the new course***

308 The course was part of an educational project involving four partner higher education
309 institutions (HEIs) (Table 1). The cooperation must be seen through the lens of the
310 commercial and political importance of Norwegian-Brazilian relations. After the EU
311 and the USA, Brazil attracts Norway's has next largest foreign investment, and over
312 100 Norwegian companies are established in the country (Norway 2020). Sustainable
313 development is a paramount principle in bilateral relations. Norway is the largest donor
314 to the Amazon Fund, an initiative that champions an international effort to mitigate
315 climate change through REDD+ (Reducing Emissions from Deforestation and Forest
316 Degradation) and also encourages the sustainable management of forests and the
317 conservation and enhancement of forest carbon stocks (Correa, van der Hoff, and Rajão

2019). Despite the green profile of the Norwegian discourse towards Brazil, investments in extractive industries, such as oil, gas and mining, are predominant (Norway 2020).

[Table 1 near here]

The contrasting visions of 'post-oil' economies embedded in narratives of 'economic restructuring' (Norway) and 'post-extractivism' (Brazil/South America) offered an opportunity to discuss sustainability issues within a business development setting.

The partnership was funded through a grant from the Norwegian Agency for Internationalization of Education (DIKU) as part of the Partnership programme *UTFORSK* (Exploration) (DIKU 2020b). The primary goal of the partnership is to formalize cooperation among the four partner HEIs, and to then develop a top-rate, real-world-oriented course on sustainability and entrepreneurship that would train graduate students in social sciences (business, political sciences and public management) (DIKU 2020a).

Course design

The course's intended target audience was an interdisciplinary cohort of graduate students in management, public administration, and political sciences. The course organizers considered the nature of the participant profiles and the challenges embedded within the thematic domain, taking inspiration from Vygotsky's sociocultural theories of learning (Jarvis, Holford, and Griffin 2004) and experiential learning (Kolb and Kolb 2005). The combination of these learning theories is framed by a PBL framework (Graaf and Kolmos 2003).

342 Principles of sociocultural learning theories were embedded in the course
343 characteristics, including teamwork, guidance and coaching (Jarvis, Holford, and
344 Griffin 2004). One benefit of this approach is facilitating the interaction among
345 participants, i.e. more experienced students within teams can share their knowledge
346 with novice students. We also applied independent learning process rather than
347 memorizing through the so-called "scaffolding" skill, which is another principle from
348 Vygotsky. This implies not directly providing the students with a solution to challenges
349 put forward during the lectures but rather proposing challenging questions so that
350 students themselves find answers to the problems (Aubrey and Riley 2016).
351 The complex characteristics of sustainability challenges that necessitate
352 entrepreneurial action are also fertile ground for the integration of Kolb's experiential
353 learning principles (Kolb and Kolb 2005). We aimed to foster a learning cycle where
354 the students engaged in a concrete experience, participated in a reflective observation by
355 reviewing the experience, and then made an abstract conceptualization that allowed
356 them to conclude and learn from the experience (Kolb and Kolb 2005).
357 Following previous efforts to integrate sustainability into entrepreneurship
358 education (Karlusch, Sachsenhofer, and Reinsberger 2018), our course's
359 interdisciplinary approach could face criticism when compared to a disciplinary
360 approach. In order to mitigate this, we present the course learning outcomes next.

361 *Learning outcomes*
362 We designed the learning outcomes (ILO) of the course according to the constructively
363 aligned outcomes-based teaching and learning framework, structuring the ILO within
364 knowledge, skills and competence (Biggs and Tang 2015). The principle of constructive
365 alignment (CA) implies a close relationship between the intended learning outcomes,
366 the teaching learning activities, and the assessment (Biggs and Tang 2015). As

summarized in Figure 1, when designing the ILO, we paid attention to finding a balance between declarative and functioning learning outcomes. Specifically, given the graduate level of the course, we balanced enumerative, descriptive, and relational verbs of the structure of the observed learning outcome (SOLO) taxonomy (Biggs and Tang 2015).

[Insert Figure 1 near here]

The knowledge dimension of learning outcomes is dominated by a multi-structural level of understanding with a focus on gaining understanding. We included current discussions within political ecology on extractivism (Brand, Boos, and Brad 2017) to provide the students with an understanding of the extractive economy's transformation, with a focus on the dynamics of innovation and evolutionary change on a regional scale. We also included the concept of smart specialization, and how it can be used to identify relevant development pathways for regions affected by extractivist downturns in the international commodity market (Mariussen, Nguyen, and Løvland 2018). We also integrated the post-oil economic transformation that takes into consideration discussions on innovation systems, with an emphasis on the triple helix framework (Carayannis, Barth, and Campbell 2012). These macro-level components must also be linked to the practical implications for firms and individuals looking to innovate. In reflecting on the suitability of certain new products, processes or business models to succeed in the economy's transformation, students also become acquainted with theories and methods that can help them understand the entrepreneurship process (Brush, Greene, and Hart 2001), business model generation (Osterwalder and Pigneur 2010), how to handle uncertainties, and how to generate entrepreneurial ideas (Sarasvathy 2001).

The skills ILO reflects a relational level of understanding by combining elements from the different concepts and relating them to each other as a framework for solutions in this case. Thus, students gained skills that allowed them to identify whether an innovation system is suited for post-extractivism and whether specific entrepreneurial ideas are suited for pathway diversification in the context of post-oil development.

The competence ILO reflects the importance of embedding the course into active-learning approaches like socio-cultural learning theory, experiential learning and PBL. Specifically, these competencies enhance students teamwork abilities, reflect on complex problem analysis, stimulate intercultural learning, and improve oral communication.

Empirical materials

Participant observation

As authors, we were also involved throughout the AR process. In addition, we developed the course program, recruited students, and administered the project vis-à-vis the HEI management. A participant observer differ from a structured observer in that they take an active role in the setting being studied, thus interacting with the students, while the latter takes a distanced approach (Patton 2002). Following Patton (2002), we highlight some choices in the participant-observer method: role as full participant and insider (memic) perspective. In addition, even though the course involved several faculty staff (see the results section for further details), the team of researchers was limited to the three authors. Furthermore, our research intentions were fully disclosed to students and colleagues. The students were asked to sign a participant consent form

previously approved by the Norwegian Data Protection Agency (NSD). The observation period took place throughout the course duration.

As participant observers, our main empirical materials were field notes, defined as summaries of events, behaviors, and researcher reflections (Bryman 2012) that were made by the end of each day throughout the course. Each note included critical information, such as the date, location, name of course and lecture, participants involved, course setting, and what prompted the exchange. Whenever possible we also included direct quotations from the events. We included personal notes that reflected on strengths and pitfalls of the experience after finishing the teaching session. We also held short team meetings at the end of the daily sessions to summarize key observations such as when students gave oral presentations and received peer recommendations and comments from teachers.

As participant observers, we had access to other documents produced in the context of the course, including:

- Course documentation that comprised the learning objectives and course schedule as well as a lecture plan and reading list (see Appendix 2). It was mainly developed by the authors, but also included input from lectures.
- Students' essays of motivation that they wrote when applying for the course.
- Student work samples. Annotations in preliminary reports (week 1) and the final report (week 3), which included student reflections about the group collaboration.
- Faculty reflections on how they connected their lecture with the PBL module that were requested after the sessions. We received six reflections.

Interviewing student participants

After the course, we carried out in-depth interviews of nine students; each interview

was 25-120 minutes long (for a total of 450 minutes of recordings; see Table 2). The purpose of these interviews was to assess the elements of the problem-based module and the combination of the seven sessions (Appendix 1).

[Table 2 near here]

The authors transcribed the interviews verbatim and coded them in two iterative cycles (Saldaña 2009). The first coding cycle entailed in vivo coding of students' experiences. This inductive approach resulted in 88 items. Subsequently, through axial coding (Saldaña 2009), these codes were grouped into main categories, largely inspired by the competence framework but also related to other issues mentioned by the interviewees that we found relevant for assessment. Seventeen main categories were identified. These categories were subsequently reduced to five main themes (Table 3).

[Table 3 near here]

The analysis of the interview data reveals that most of the students' reflections focused on the way learning approaches were taught. The second most discussed themes related to the course's topics. The external collaboration with industry and companies, along with the educational focus, were marginal themes throughout the interviews. The comprehensive data structure and coding scheme can be found in Appendix 2.

Synthetizing and presenting the findings

The empirical materials collected through participant observation and interviews with the participants were organized according to the phases in the AR process (Figure 2). The results respond to the research question by structuring the AR phases of "action," "observation," and "reflection." When presenting the results, we used a retrospective

and confessional tale, meaning we integrate our critical reflections with evidence (quotes from interviews) or other empirical materials (Miles, Huberman, and Saldaña 2014).

[Figure 2 near here]

In the interview materials, we were particularly interested in assessing how the students perceived PBL in combination with the sessions and with the other elements of the course (intercultural learning, post-oil). Therefore, we report in the results section the students' reflections in relation to the PBL framework. As a result, even though the interviews provided reflections on multiple issues, we coded them using the PBL categories. We grouped the students' reflections according to the PBL phases of problem analysis, problem formulation and problem solving (Lund and Jensen 2013). The students' reflections are thus integrated as part of the section on course delivery.

Results

The course was organized as a summer program for the Norwegian partner institution, and thus as an elective course for the participants from HHN. The summer program involved a trip to Brazil to participate in the module 1 course activities. A call for participants was announced seven months before the start of the program, and the final selection of participants was based on criteria such as a motivation letter and academic background. A total of 18 Norwegian and Brazilian students participated in the three-week summer school. Twelve students received a mobility scholarship to visit the partner university in Norway or Brazil. Six students participated in all academic activities, including group work, but did not attend the third module lectures in Norway. The background of the students was diverse: four students were from management, two

students were from sociology (HHN), one was a graduate student in economics (UFRJ), seven students were in public administration (UFF), and three students were in a masters of education and engineering management (IFRS) program. The participants also had a diverse age range and varied professional experience.

The three-week course was conducted in three modules, as outlined in Figure 3. The three modules represented the ILO approved for the course and have been previously presented. The course also integrated the platform Moodle for sharing practical information, shared reading lists for course preparation, participant forums and assignments delivery. Most lectures within module 1 were given by staff from the partner universities and took place in Rio de Janeiro (Appendix 2). Module 2 took place in Bodø (Norway) and was facilitated by staff from the local partner university in Norway. Modules 1 and 2 were closely linked to the PBL organization of the course (module 3).

[Figure 3 near here]

Considering the experience of integrating PBL into course work, we combined the lectures of sessions 1 to 7 with activities directly related to module 3. As much as possible, this combination took place within each session (Figure 3). Session 1, besides introducing the summer course, allowed each participant to introduce themselves (day 1). Session 1 also included socio-cultural learning, providing contextualized learning to visiting students as it overviewed the Brazilian economic context. In connection with the PBL module, students introduced themselves in terms of where and what they were studying but also their motivation for taking the course. Given the students' heterogeneous background, we believed that getting to know each other and sharing joint interests would facilitate group formation amid cultural differences.

Group formation

Session 2 was a key session because it introduced the overall thematic area of post-oil economic development trajectories, linking it with the themes of innovation and entrepreneurship. During the second day of the course, the students formed groups by identifying common interests through a "café dialogue" group dynamic. The purpose was to create diverse and interdisciplinary groups with members from different universities, programs and countries. The dynamic involved setting four tables, each with a different title ("eco-innovation", electric cars, societal transition, education), and every five minutes students had the opportunity to join a table and discuss the designated topic with others. After three rounds, students decided which table to join, forming groups of four to five students. Our observation of the café dialogue dynamic showed that this allowed the participants to engage in enthusiastic discussions and sharing of ideas, even though they came from diverse academic and cultural backgrounds.

Students appreciated the café dialogue approach to forming groups (Int. 7). Similarly, students liked the idea of comparing themes and meeting other students who had some shared interest:

> So, I was moving in all four groups, at first there were like four different headings. I participated in all four groups with an open mind, considering that if there's some new possibilities, I will join them. (Int. 6)

Previous knowledge played a role in students' selection of the theme and ultimately of the group they worked with. The café dialogue took place before any lectures:

> I think everybody had an idea of what eco-innovation was, if we want to work with this concept because it is intriguing, it's interesting and is also something that is future related. (Int. 7)

Even after students chose a table theme, what this meant in practice was not always evident. Therefore, discussions and negotiations about the project focus also took place at this initial stage:

> When I was talking to student E. P. and A. I got an idea about eco-innovation. Later, together with E., I discussed having a focus on entrepreneurship instead. We ended up doing that anyway, talking about policies and the role of the government and other things. (Int. 6)

When students reflected on the group formation phase, they also observed that in addition to shared interest in a theme, mixing experienced and novice students helped to improve the group:

> It is true, in our group, all having a common language helped us to create affinity, better exchange our points of view. However, the most important thing was to have a good blend of experienced and non-experienced student s. (Int. 3)

Problem analysis

The problem analysis phase extended from part of session 1 to session 4 (Figure 3). During sessions 1 and 2, students had the opportunity to develop small group assignments and discussions as part of the associated lectures. The lectures presented experiences from industry sectors representing the "post-oil" economy in Brazil, and the teachers set aside time for group discussions. They were careful to link how the lecture content could relate with a problem definition (stage 2 of the PBL process).

The third session included elements of experience-learning as students had the opportunity to attend lectures in the largest science park in Rio de Janeiro (UFRJ campus). For students, being on the ground with several industries from the "post-oil" economy sparked inspiration in framing the problem area. During the visit, students heard accounts from companies within the creative economy, biosciences and renewable energy.

Session 3 took place at the Volta Redonda campus of UFF. Volta Redonda is a city well-known for its steel industry and is at the core of the car-manufacturing industry cluster. Session 3 included guest lectures from a car manufacturing company and a visit to an outpost in the steel industry valley. The visit and the experience of learning about factors driving car manufacturers to consider electrical vehicles were part of the group discussions and question-and-answer sessions with teachers.

During the fourth and fifth days, students worked in groups to define a research question for their project, drawing inspiration from sessions 1 to 3 as they framed the problem area. The first week concluded with group presentations. Four initial project ideas and initial problem formulations were presented that took into consideration key challenges facing the transition towards a post-oil economy in Norway and Brazil. The problem frameworks dealt with issues such as electric car technologies, the role of educational programs, policies for dealing with plastics in the oceans, and framing ecological thoughts. As part of the seminar, students received peer feedback and delivered a PowerPoint presentation with reflections on their experience with group dynamics. The reflections and the comments during the peer feedback session indicated some challenges had been felt when trying to define a relevant research question. Students appreciated the feedback they received by the end of the session that allowed them to improve their research frameworks.

When asked about their experience during the problem analysis phase, interviewees highlighted experience as the determinant factor used to focus the group discussions and filter ideas:

> Students without much experience are often looking to stand over the others; those with more experience are more mature, they don't have that need. Instead they focus their energy to help the group progress in their tasks. (Int. 5)

During the initial phases of problem analysis, experience played a key role in problem formulation and in choosing a post-oil perspective to develop the projects. More experienced students often built the problem analysis on issues they dealt with every day as part of their jobs:

> At some point we were unsure how to proceed methodologically. Then student D. picked up the idea of working with MOOCs, which later we built our paper on. All materials are available online. (Int. 5)

This student claimed that he had worked 22 years in the administration of a Brazilian university and before that he was an IT entrepreneur (Int. 5); therefore, his contextual knowledge obviously helped him to guide the group choices at this initial stage. Besides experience, students also highlighted complementary skills as something that moved the groups forward during initial discussions and framing:

> I felt like my understanding of how things work came from my social sciences perspective. I was the only social science scientist in my group. [Student G.] is a philosopher and the two others are from the business school. We came from different perspectives, so I really think I brought something to the table when I, when we discussed ideas, discussing where we are going and so forth. (Int. 7)

In addition to the interdisciplinary combination of group members, the students highlighted the problem analysis tools as a great support in identifying their key issue (Int. 5). As the course progressed, group discussions provided a good arena to reflect on the theories learned during the lectures. An example is a theory used to understand the agency of universities in societal change, namely the triple helix, which is related to socio-ecological issues relevant to post-oil and the students' own experiences:

> After the lectures, I was having a debate with [Student E.] regarding the triple helix because we had different opinions about the meaning of triple helix and its different parts. So, talking about that, I told him that I have an interest in the ecological relevance of the model for Norway because I also studied plastic pollution. (Int. 6)

Some students argued that the initial problem analysis was difficult because the groups were large and most of their ideas were therefore too unfocused:

> At the outset I had difficulties collaborating and contributing to the discussions. In group work, the person who speaks the most can impose his/her ideas with ease; the others, as result, fall behind. I prefer that tasks are fairly distributed from the outset. In Rio, when we were five in the group, we did not manage to identify a focus FOR our project. In Bodø, working closely together with [Student D.], we made better progress. (Int. 5)

Problem solving

The third week of the course started with session 4, the last part of module 1 that also contextualized the thematic importance of module 2. In the PBL context, module 2 lectures aimed to inspire students to identify solutions to the problems they had previously identified through module 1. Session 4 supported the groups' projects by introducing the topic of "smart specialization" and was organized as a workshop. Students worked in groups to discuss how this concept could be used in their projects. Students then presented their results and received further feedback. During session 5, students had the opportunity to begin developing possible solutions to their post-oil transition problem through entrepreneurial solutions. How session 5 was delivered facilitated this task. It integrated experiential learning as students had the opportunity to visit the science park in Bodø, where start-ups presented some of their products. The discussion between startups and students allowed them to receive feedback on their project's ideas and products while taking into account market conditions. Subsequently, with the support of the Engage centre at HHN, session 5 involved a workshop focused on creativity.

Session 6 was took the form of a business modeling workshop that used tangible objects to spur discussion on the students' projects (Buur and Mitchell 2011). The workshop introduced the business model canvas to students through a case study of the mobility as a service (MAAS) business model. After watching a video, students had to discuss various potential MAAS business model scenarios depending on future post-oil

trends. The discussions during the workshop provided some reflections about the inclusion of the concept of a business model in students' projects.

The last session (7) was an opportunity for students to extend their knowledge of sustainability and social entrepreneurship experiences in Brazil and Norway. The session was organized as a panel discussion, where teachers discussed case studies in both countries and allowed students to reflect on how their projects could integrate these solutions.

All students had previously worked in groups during their various educational programs; however, for many of them integrating ideas from other disciplines was something new. This interdisciplinary integration proved to be a challenge when developing a project on post-oil:

> [Student E.] proposed focusing on something with development policies. [Student P.] and I were mostly interested in the ecological implications of the ecological theme for Norway, plastic pollution, because it helps both of our studies. P. is also working on climate change, an issue affecting everything. (Int. 6)

Other groups, facing similar situations, framed the project around an idea inspired by one of the members with more experience:

> Personally, I had certain interest in including some elements of cross-analysis [of MOOC education]. I was afraid it could jeopardize our work at the time. Hence, I refrained from mentioning it. I'm indeed convinced we made the right choice and we are preparing a good report. (Int. 3)

Students often highlighted how communication and exchanges of ideas emerged during the group work. In an intercultural learning context, it is interesting to note how Brazilian students assessed the Norwegian students as posing critical questions; at the same time, language barriers prevented a full sharing of critical ideas in relation to other opportunities:

> Yes, we had this [Norwegian student], who was always teasing us, in the good sense; she was provocative, asking the critical questions: "This must improve, right?" I found it superb, very positive. Sometimes [Brazilian student] was quite reserved, afraid of not finding the right English term. Even if my English is not perfect, I share my ideas, no

> problem if I make mistakes. At the end [Brazilian student] also managed to share his ideas. (Int. 4)

A number of factors played a role in helping the group integrate previous knowledge with new knowledge delivered through the lectures. Among the factors mentioned by students are critical interactions through questioning but also leadership through previously matured ideas (Int. 4).

Students faced some challenges during the problem analysis process, such as moving from brainstorming to actually writing the project. As interviewee 5 put it:

> One difficulty we passed through was transitioning from the stage of internal debate and brainstorming to the actual project writing. It was extremely difficult for our group. At some point, it was like all the members tried to convince the others to integrate their own ideas. Getting approval from the others and moving ahead was time consuming. (Int. 5)

Another challenge was fitting the PBL framework into a short summer course timeframe. The limited time allocated to developing the project had consequences for how students budgeted their time and planned the scope of their projects. As interviewee 7 highlighted:

> I think we were pretty set on our idea, it's just that it was too huge for just a two-week assignment. We weren't narrowing it down to a manageable substance for a manageable timescale, and that was the problem because I recognized when we had the lecture with the PhD candidate that suddenly my idea is worthy of a PhD proposal and that is way too much for two weeks. (Int. 7)

Discussion

The purpose of this article was to understand how entrepreneurship and sustainability learning objectives can be integrated into a higher education course. It was hoped that a PBL framework would provide students with the contextualized learning needed to creatively solve complex problems. A clear societal challenge was used as the discursive context. Given the socio-political importance, the organizers named this discursive context the "post-oil" economic transition.

Relying on classroom AR methodology (Jennings et al. 2015; Johnson-Burel, Drame, and Frattura 2014), this research used qualitative inquiry. The empirical materials were built from participant observation, student work samples, course documentation, and in-depth interviews with nine student participants. The material was organized following the AR process: course planning, course delivery, assessment and reflection. The guiding research question was: How is active learning best integrated into a higher education curriculum with entrepreneurship and sustainability learning objectives?

In the course structure we used in our study, PBL pedagogy was integrated as a group-based project that was also used to assess the course. Our framework sheds light on the relationship between the key principles of PBL and the thematic balance of sustainability and entrepreneurship education in the curriculum, on the process of integrating PBL into course design, on related tension points, and on strategies to tackle those tensions.

In the results section, we reported on our course delivery experience. The narrative also engaged interview results with a focus on the PBL aspects of the students' experience within the course. Figure 4 summarizes our interpretation of the course delivery process through a PBL framework.

[Figure 4 near here]

After conducting the course, we identified tension points along the PBL process. The first tension, which we call "timing" (Figure 4), emerged early in the group formation phase. In the context of our short courses integrating PBL at the graduate level, it is often common to have diverse groups (in terms of discipline, experience, and cultural background). This study also included a highly diverse group of students who

were from different countries and study programs, as highlighted in the results. Thus, it was difficult to avoid having students from similar backgrounds join the same groups (e.g. those from the same university or program). Meanwhile, during the group formation stage, we set up a framework to align students' diverse interests and maintain self-directed learning principles. We achieved this through the café dialogue dynamic, which allowed a relatively quick alignment of interests and the identification of group leaders who were experienced in one of the themes. As the students mentioned, the initial ideas evolved during the three-week period of the course. These changes in the problem analysis also indicate the importance of the lectures during the later phases of the PBL process.

A second tension was the quality of the problems that students can develop and subsequently 'solve' in connection with the course's learning objectives. Here is one aspect in which PBL differs from the case study teaching method, namely the relative freedom students have to structure their own problems (Graaf and Kolmos 2003). The background of this tension is often portrayed in the PBL literature as a wide difference of problem integration approaches across programs and disciplines. We framed the initial problem within a broad theme and subsequently allow students to scope it with relative autonomy and freedom from teachers' influence; this contrasts with other course designs in sustainability and entrepreneurship education, where the teacher's role is more important (Ban et al. 2015). Yet this can introduce tension as students formulate and scope the problem. To tackle this tension, we allowed students relative flexibility in problem formulation during the course. An initial problem analysis was carried out by the end of the first week, and subsequently, students modified this problem formulation according to inputs they received during modules 1 and 2.

A third tension emerged in relation to the two broad themes of the course: on one hand, it encompassed sustainability as a societal transformation interlinked with regional planning aspects of extractive economic development, and on the other hand, it referred to micro-economic issues linked to entrepreneurship (new business development, creativity, start-ups, technology). The students' overall feedback about how both themes were combined in modules 1 and 2 indicated that while the scope of the themes can be broad enough, it is extremely important to have a common thread that aligns the PBL principles. In our course, the common thread that helped to focus these discussions was the discussions about phasing out an oil-dependent economy. Engaging this theme also allowed us to maintain a balance between the two educational areas sustainability and entrepreneurship education, which have both generated associated research and education experiences with PBL. From this perspective, our approach also differs from previous graduate courses that adopt PBL as the guiding pedagogical approach but focus overwhelmingly on one of the two issues (either environmental planning or new business creation) but do not combine them into single PBL projects; examples of these experiences at the graduate level are listed in Ban et al. (2015) and Rossano et al. (2016). To address the third tension we provided formative feedback to students during the learning process and not after, with the intent of ensuring that any student mistakes that affected their assignments was caught on time and that reflection would be integrated into their work (Biggs and Tang 2015). Inspired by other experiences of formative feedback in PBL contexts (i.e. Spliid and Qvist 2013), we used multiple types in our course: reflections during group work, oral presentations where students received peer recommendations and comments from teachers, meetings with tutors during group work, and self-assessments where students had the opportunity to critically explain their group collaboration.

Reflections on action research as a methodological framework

One inspiration for this study came in the form in which sustainability is taught in higher education. It is still considered to be "modular," seemingly disconnected from more core aspects related to economic development and management. AR allowed us to first allowed us to reflect on our institutions primarily through academic debate on new ways to blend sustainability education with core management subjects like entrepreneurship. We connected this reflection with earlier publications that link AR with sustainability education and identified some of the benefits of AR such as coping with practical situations, developing professional competences and creating a sphere in which professional and practical discussions on education can occur (Posch, 1993). The ultimate aim of this research is to create a change in the way environmental education is perceived, shifting it from being at the margins to making it a more central part of the school curriculum (Posch, 1993). AR was thus beneficial to our project since a related goal was to bring sustainability education into the mainstream through the development of new teaching methods.

The revision phase in the AR cycle also seeks to reflect on changes to the original plan. Our experience throughout the different phases of the AR legitimized our contribution to pedagogical developments in the study programmes as we collaborated with the institutions participating in the AR project. In concrete terms, we manage to portray sustainability, PBL, and internationalization as integral parts of a new course (called Leadership in Practice and organized by the Norwegian partner HHN, involving the same partner institutions). The AR process also gave the Brazilian partners the freedom to modify the practical elements of their pedagogical planning, including the adaptation of didactical elements tested through the course (i.e., gamification, flipped classroom, etc.). Combining AR and the PBL methodology also allowed the Brazilian

partners to propose new solutions to issues that arose amid the context of the COVID-19 and subsequent extended campus closures. Worldwide, there is a need to interface new teaching practices with online learning methods. The project partners are thus building on PBL and AR in order to learn about graduate students' professional experience in combination with online learning. Students attending these courses combine work with studies, and thus bring their real-world experiences into the classroom.

On a micro-level, we also experienced the "second order" action research, or the reflection of our role as AR facilitators (Magyar & Mayer, 1998). As facilitators we experienced some dilemmas as producers of knowledge, a role the project funders required we take on. We were also embedded within organizational structures with divergent priorities. AR allowed us to "test-in" new collaborations and teaching methods and to develop new course offerings by setting aside longer-term administrative concerns, such as budget and academic credit recognition from international universities. As previously highlighted by Townsend and Thomson (2015), AR can go beyond a utilitarian approach of identifying problems and seeking solutions, to actually creating educational experiments that can be sustained in the long term.

Conclusion

As entrepreneurship education gains momentum across higher education institutions worldwide, it is key to think critically about its contribution to training the next generation of entrepreneurs who will create value for stakeholders and the environment – not just shareholders. In addition, discourses across the private and public spectrum seem to converge to provide new potential roles for entrepreneurs, such as those working towards sustainable development goals or tackling market externalities.

This paper engages in this discussion and contributes to a better understanding of how sustainability can be combined with entrepreneurship education. We developed a conceptual framework for making sustainability education more entrepreneurially oriented in higher education; this was achieved through a problem-based learning process. This framework was further tested through a course designed in the context of a summer program, while students' evaluation of the program offered ways to improve the course design in the future.

This paper also has practical implications, including a framework that can be used to design new educational programs combining sustainability and entrepreneurship objectives in graduate programs. Since the framework was developed in collaboration with partner programs in Norway and Brazil, we also provide a detailed overview of three potential tensions that course designers might face and ways to address those tensions right from the start.

As with other studies following a classroom action research approach, this research has limitations in terms of external validity. The transferability of our results and analysis can be evaluated by comparing our original context to that in which the study is to be replicated. To facilitate transferability, we provide a thick description of our setting. Further contributions could enhance our framework by analyzing in greater detail the role of formative feedback during the different phases of the PBL process, as this seemed to be our key strategy for addressing tensions at the group level and finding a balance between entrepreneurship and sustainability issues. Quasi-experimental designs could be particularly useful in this research.

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APPENDIX 1 – QUALITATIVE INTERVIEW GUIDE

- Part I: Student background
    - Field of study/work experience
    - Business experience
    - Sustainability experience
- Part II: Content and structure
    - Combination of activities
    - Structure
- Part III: Interpersonal interaction
    - Social
    - Group work
        - Report an issue
        - Report a good thing going on in your group
- Part IV: Self-assessment
    - What have you brought from your previous experience and how has it helped you further progress in the course?
    - How did you contribute to the whole project?
- Part V:
    - Perception/knowledge before vs. now about this topic
    - Did attending the summer program make you think about different plans for the future?

APPENDIX 2- DETAILED COURSE PLAN AND CODING OF INTERVIEWS

The detailed course plan and comprehensive thematic coding of the interviews is available as open data through the following link. The interview data information has been anonymized to comply with the Norwegian Data protection requirements (NSD):

https://dataverse.no/privateurl.xhtml?token=1e52238e-b6f2-4614-8c6d-aca2b597ca91

Table 1: Norwegian-Brazilian cooperation in higher education for sustainability and entrepreneurship education, partner universities

University	**Institutional Profile**	**Academic Unit involved in the project**	**Relevant assets to the thematic area of cooperation**
Nord University, Norway	Public HEI; 12,000 students; 1,200 faculty staff	Nord University Business School (HHN)	Third largest business school and the largest provider of MBA programmes in Norway. *Engage* (Centre for Engaged Education through Entrepreneurship)
Fluminense Federal University (UFF), Brazil	Public HEI; 65,000 students; 3,500 faculty staff	Institute of Human and Social Sciences	Masters Programme in Administration (PPGA)
Federal University of Rio de Janeiro (UFRJ), Brazil	Public HEI; 60,000 students	Institute of Economics	Masters and Doctoral programmes in Economics; Public Policy and Development
Federal Institute of Rio Grande do Sul (IFRS), Brazil	Public, technical education, 19,000 students across 17 campuses	Vice-Provost of Research	"Close-to the community" HEI, through a diverse range of service-oriented learning activities. Sustainability education (Eco-Viamão project)

Table 2 List of interviews

Interview ID	HEI's country	Study program
1	Brazil	Management
2	Brazil	Economics
3	Brazil	Management
4	Brazil	Economics
5	Brazil	Management
6	Norway	Management
7	Norway	Sociology
8	Norway	Sociology
9	Brazil	Engineering

Table 3 Data structure of the empirical materials (the number of codes linked to a particular category are given in parentheses)

Categories	**Themes**
Real-world oriented (6) Problem-based learning (23)* IT in pedagogics (1) Improving the course (8) Course structure (4) Course implementation (1) Course impact (5) Active-learning approaches (9)	Teaching learning approaches
Post-oil discussion (10) Innovation design (2) Entrepreneurship ecosystem support (1) Sustainability literacy (1) Social entrepreneurship (1)	Main themes tackled by the course
Practice (5) External collaboration (1)	External collaboration
Faculty training (3)	Educational focus

*Focus of the analysis

1138 Figure 1 Intended learning outcomes of the course

Knowledge

- Gain an understanding of the hegemonic and counter-hegemonic discourses about extractivism and post-extractivism in the context of Norway and Brazil.
- Gain an understanding of the main theoretical approaches to understand innovation dynamics at a societal level with emphasis on triple helix and innovation systems.
- Gain an understanding of the concept of smart specialization and how it can generate windows of opportunities in Norway and Brazil.
- Gain an understanding of the entrepreneurial process, with an emphasis on entrepreneurial opportunity identification and exploitation.
- Gain an understanding of business model concepts and explore how entrepreneurs and innovators can use them as a tool.
- Become familiar with the main aspects of design thinking, new product development, and new venture creation; the elements of what it takes to be an entrepreneur.

Skills

- Be able to analyze the main components of innovation systems at a national and regional level. Will be asked to answer questions such as: What can predict whether or not an innovation system is suited to post-extractivism?
- Critically outline the consequences of development pathways focused on extractivism at national and regional levels. Explore the implications of smart specialization as a pathway diversification strategy.
- Identify the conditions necessary for certain entrepreneurial ideas to contribute to path diversification and the conditions necessary to exploit the market opportunities around these entrepreneurial ideas.
- Be able to use tools, such as the business model canvas, to plan for business ideas in the context of new products, services, or processes developed in the context of post-extractivism.

Competencies

- Increase their ability to analyze complex problems and frame them as a research questions.
- Gained competence in collaborating in team work with intercultural groups and using digital learning tools.
- Increased their ability to reflect on and consider theoretical problems in a general sense in research.
- Increased their ability to communicate problems, analyses, and results to colleagues both orally and in writing, including by contributing to academic debates.

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1141 Figure 2 Links among the AR process, methods and the results

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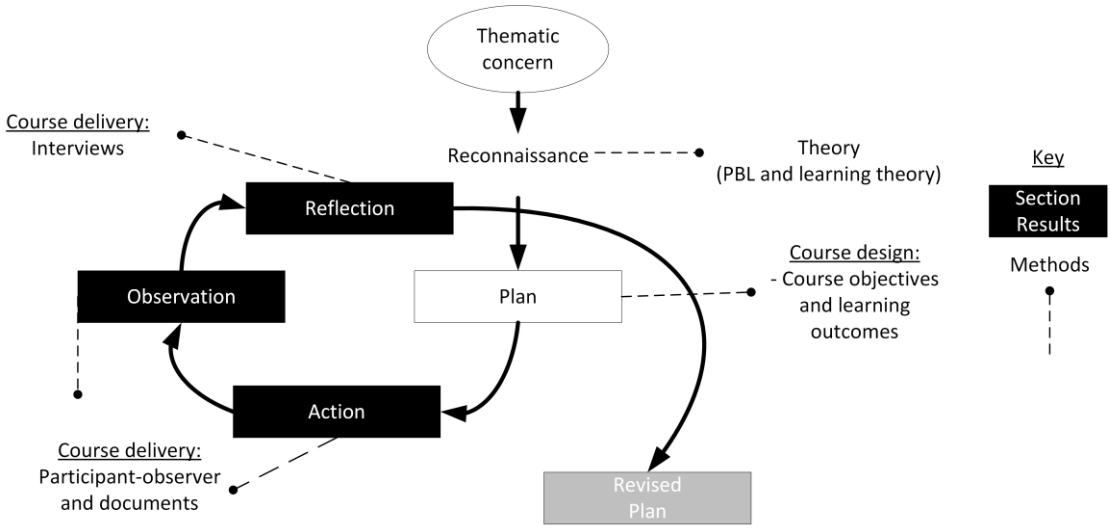

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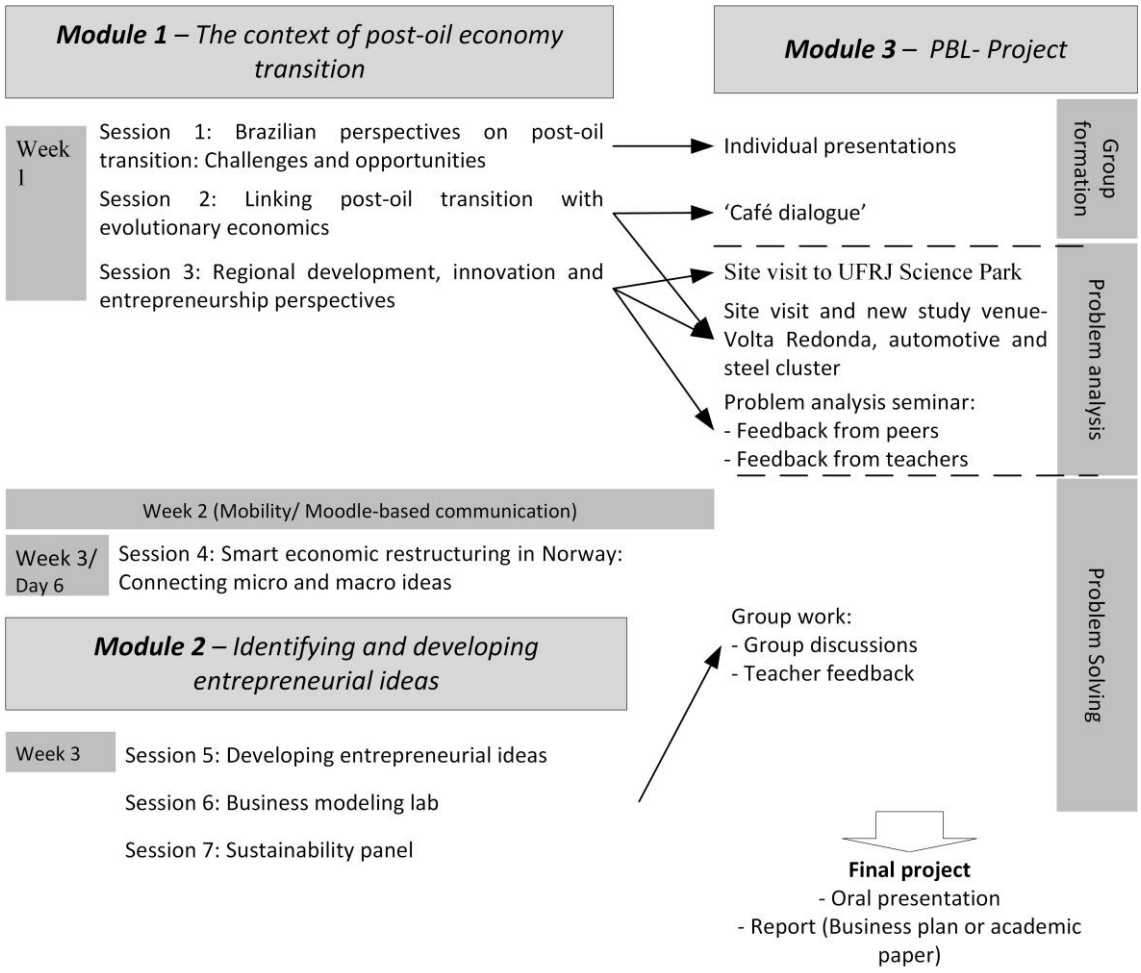
Figure 3 Course structure in three modules and seven sessions. Relation between the modules and the PBL process and activities



1151 Figure 4 PBL process framework, tension points and strategies to address the tensions
1152 in the course program
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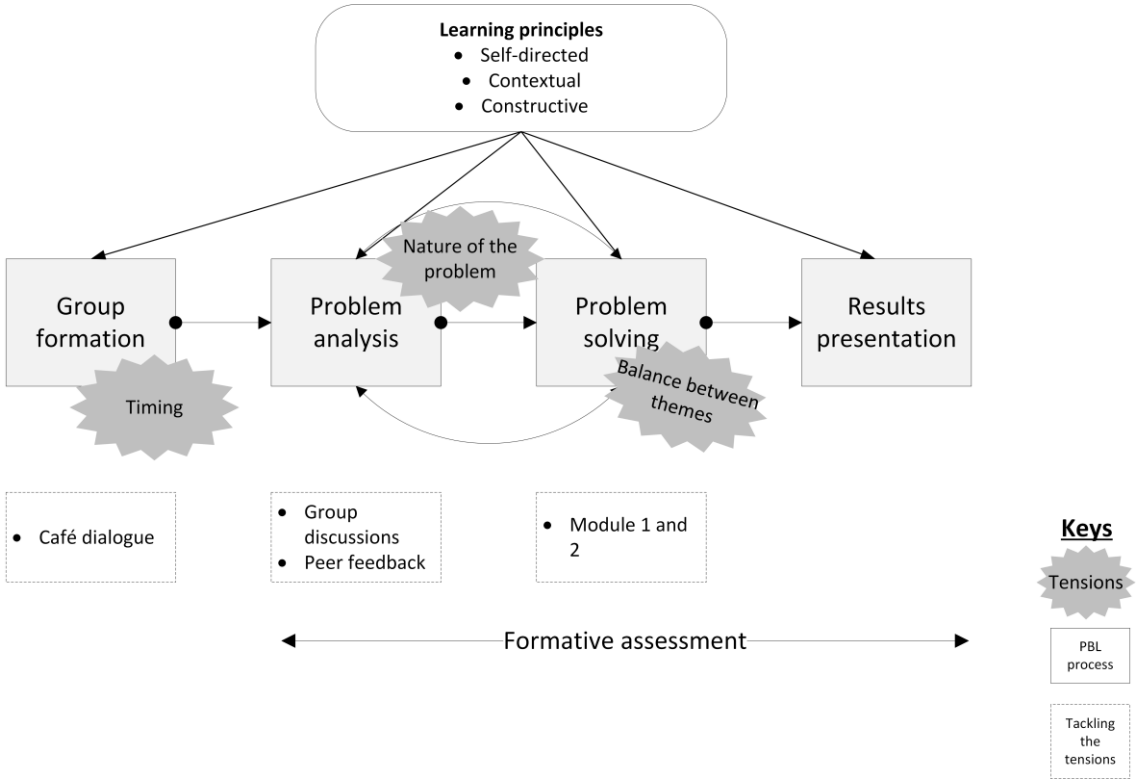

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