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Digital Tools and Experiential Learning in Science-Based Entrepreneurship Education

Marlous Blankesteijn and Jorick Houtkamp

Introduction

This chapter assesses the use of digital tools in experiential learning in entrepreneurship education, namely science-based entrepreneurship education (SBEE) (Blankesteijn et al., 2020). SBEE refers to entrepreneurship education in science faculties, whereby fundamental scientific research in physics and chemistry is a vantage point to develop entrepreneurial activities for and with students. SBEE requires students to learn how to cross the valley of death between fundamental,

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natural science, and application on the one, and commercialization on the other hand (Retra et al., 2016). A crucial component in teaching SBEE is that students experience the challenges in transferring science to the market and society, in order to create commercial and social value. These challenges are referred to by the "the valley of death" between science and innovation. The valley of death is a metaphor developed by Barr et al. (2017) in order to conceptually capture the gap between research and commercialization of research, between researchers and entrepreneurs and investors.

The main task of academic education has for a long time been conceptualized as a preparation for students for a research career only. SBEE recognizes that the "first mission" of a university is providing a training in scientific research. However, especially with regard to entrepreneurship education, permanent interaction with professionals outside academia is important as well. Entrepreneurial action needs to be grounded on scientific evidence that contributes to building support for upscaling the technology and to cross the valley of death, thus combining the research task with the aims of entrepreneurship education. To achieve these aims SBEE programs draw upon experiential learning to facilitate entrepreneurial engagement and to enable meaningful student development, while acknowledging also the rich potential of such experiences to be translated into academic contributions on how to cross the valley of death, such as scientific publications.

Experiential learning on how to cross the valley of death is thus an essential element of SBEE. Experiential learning is a form of learning whereby real-worldness, ill-defined problems, execution and reflection are essential design principles in transferring real-life experience into academic education (Perusso et al., 2020, 2021). In science-based entrepreneurship education, students need to gain experience with the process of transferring scientific knowledge and subsequent innovation to contexts of application and commercialization.

A SBEE program recognizes that crossing the valley of the death, through starting a new firm or by commercializing science in an existing firm, requires engagement with different types of professionals such as scientists, engineers, business developers, innovation managers, clients and consumers. By incorporating engagement in their educational programs, students are enabled to play a more active, co-producing and co-creating role in their higher education experience (Dollinger et al., 2018). This experience is mediated by digital tools and potentially enriches the learning experience—such as Canvas, online communication platforms and online guest lectures. How do these digital tools enable and enrich experiential learning in science-based entrepreneurship education?

By drawing upon the work of Perusso et al. (2020, 2021) a set of design principles for effective experiential learning is formulated. It is analyzed how digital tools contribute to experiential learning projects in the SBEE program. Digital tools enable students to replicate the real-world experience in science-based entrepreneurship education, at least to a certain extent. One question is to what extent digital tools enable students to experience the difficulties in transferring science to business. To assess this, these design principles are used.

First, this chapter puts science-based entrepreneurship education in the broader context of challenges that have been identified with regard to the innovation ecosystem in The Netherlands and presents the two educational programs as a response to these challenges. Secondly, a theoretical background on experiential learning is presented and four analytical categories are developed based on the scientific literature on experiential learning in management education. Thirdly, the contribution of digital tools to convey the "real experience" of entrepreneurial action based in science will be critically assessed. Their contribution of digital tools to experiential learning is assessed in the context of the bachelor's and master's program Science Business Innovation (SBI) at VU University Amsterdam. In these programs, aspects of the real world are simulated by using digital tools in order to convey the experience of science-based entrepreneurship to students. How this is done is evaluated in the next section. By way of conclusion, lessons are drawn on how digital tools may further enhance science-based entrepreneurship education.

Entrepreneurship Education in a Science Context

Traditionally universities produce disciplinary-based knowledge. Their position is shifting to include interdisciplinary research (Blankesteijn et al., 2019) in which managerial complexity of application of science through innovation is fully acknowledged. This type of research helps to close the "relevance gap" in management education (Perusso et al., 2020)—that is, the extent to which management education prepares students for real life, "wicked" management problems for which a traditional theory-based management education program does not prepare them sufficiently. One driver of this development at universities is the idea that economic progress can be achieved by innovation from science. However, despite increasing scientific knowledge the commercialization from new scientific findings remains limited.

A SBEE program incorporates involvement with both type of market actors and their real life challenges. The challenge is to connect market actors to newly developed, early-stage technologies (Meadowcroft, 2009). Incumbent market actors often experience creative limitations andreluctance to experiment, adopt and scale-up alternative science and technology-based business models. New market actors (e.g. entrepreneurs) might be less hindered by these constraints but are confronted by gaining legitimacy such that their innovative products and services are accepted by the market.

The SBI master's program at the Vrije Universiteit Amsterdam is an SBEE program that approaches commercialization from new scientific findings as an knowledge production process with organizations in the broader regional network in order to stimulate university-industry technology transfer. Important is the development of soft skills through interaction with industry experts. These interactions help students in practicing with pitching entrepreneurial opportunities and gaining resources to enable entrepreneurial experimentation. Within the walls of the academy students are stimulated to develop a solid understanding of natural sciences. In addition, students are trained to use business and innovation theories to analyze and develop business practice based on evidence drawn from these theories. This combination enables them to make and elaborate on smart, strategic choices. All steps are mediated by digital technology in the classroom. Also due to the current COVID-pandemic, there currently is ample experience with using digital tools to replicate aspects of the experience of science-based entrepreneurship. This chapter uses these experiences to explore the value of digital tools in bringing in the experience of science-based entrepreneurship in its full managerial complexity into the classroom.

Finding the balance between the exact sciences and managerial and entrepreneurial realities is a unique challenge for each technological innvation, because the application context is always different. This also requires to develop digital didactics unique for each course and level of the group of students. As the student's experience and knowledge increases, more freedom can be offered and more responsibility can be demanded to demarcate research into relevant subjects.

Students first need a generic understanding of the innovation process. The innovation process in which students are taught to develop entrepreneurial actions is conceptualized in the program as the innovation chain (Berkhout et al., 2010). Explanations of this chain are repeated throughout the program as the backbone of the understanding of innovation trajectories and opportunities to become entrepreneurial.

Students choose a real-life case and position it in the innovation chain. The innovation chain conceptualizes the process of converting science to business through innovation. New knowledge is created at universities and in science-based organizations, providing the science base. In between universities and R&D intensive industries, enabling technologies are developed that are brought one step further, into prototypes, at technology platforms. Then new products and services are developed, appealing to existing market needs or creating new markets. This needs to be combined with the creation of new consumer needs, or the alteration of existing ones.

Figure 10.1 exemplifies the "mental movement" students need to make in order to develop an analytical understanding of the case they are researching. Students start with identifying drivers and barriers, existent in the process from moving from left to right in the innovation chain. They then choose a particular set of drivers and/or barriers, and thus

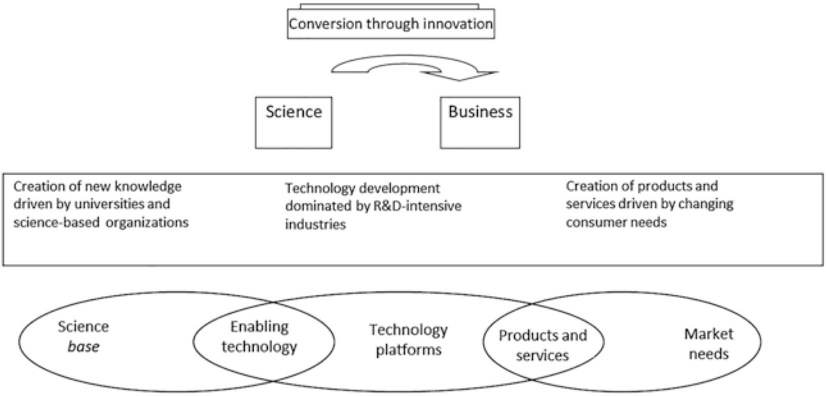

Fig. 10.1 The innovation chain (Berkhout et al., 2010)

position their case study in the innovation chain. This is a purely conceptual exercise, not involving the use of digital technology yet (Fig. 10.2).

They then choose a real-life case of science-based innovation. They interogate scientists, experts and other stakeholders involved in order to develop a preliminary idea of what is the main type of problems they face in moving from left to right in the innovation. They also do research whereby they use databases on the web, helping them to develop digital literacy in science and scientific research. Problems might for example be grounded in collaboration with external parties. Then they conceptualize that problem, using theories from the management of innovation literature, again drawn from digital databases. If the main problem is related to collaborating with external parties, for example, a suitable theoretical approach to analytically understand the case is "open innovation" (Chesbrough, 2004). They then choose that theory to further dive into and apply it to the case, to get a better sense of the underlying mechanisms at work in the innovation chain, either driving or hampering a movement in the process from left to right.

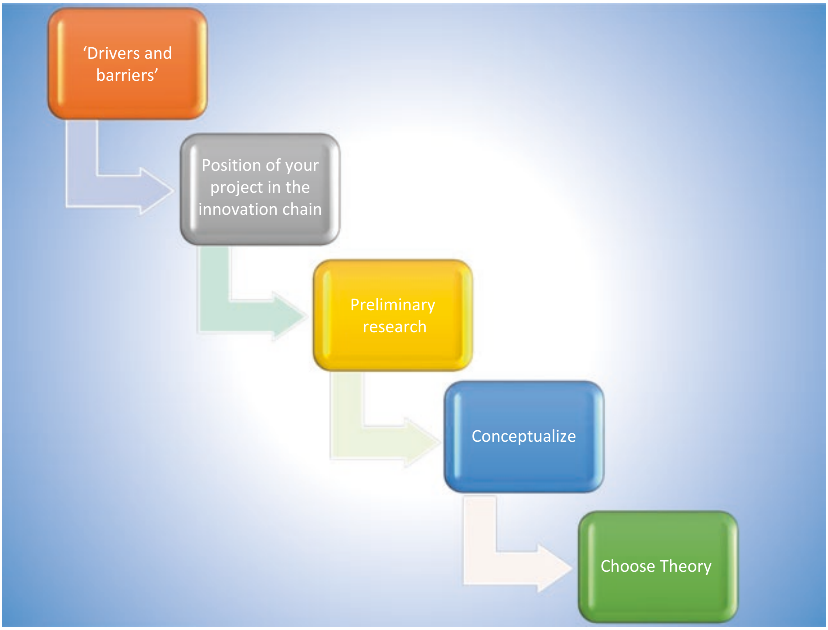

Fig. 10.2 Conceptualization of the underlying mechanisms in a case based on theory

Experiential Learning: Design Principles

In order to assess and thus develop recommendations on how to further optimize the learning effect of experiential learning in SBEE via digital tools, experiential learning theory is operationalized here and four design principles of experiential learning are presented. Perusso et al. (2020) suggest that the experiential learning environment should consist of a real-world context, with ill-defined problems, and require student execution, followed by an element of reflection.

Real-Worldness

The first design principle of experiential learning is real-worldness (RW) because students should learn to deal with elements of uncertainty, pressure, moral judgments and risk while working on university-industry technology transfer. An authentic work environment allows learners to acquire the dynamic and "culture of the practice". Sharing such insights with the class while conducting case-study research could unlock discussion of both broad and specific implications of theory for practice of university-industry technology transfer.

Ill-Defined Problems

The second design principle is that cases should consist of an ill-defined problem (IDP). Students need to learn how to identify and frame university-industry technology transfer. Traditionally, cases have clear (learning) goals to help students learn, understand and synthesize theory. Information and answers can be clearly be found in the learning materials. However, the nature of a experience in the real world is often complex, unstructured and might disrupt current logic; therefore, it might benefit learning if cases are ill-defined.

Execution

The third design principle is execution (E) because students should learn how to deal with adaptation. By testing potential technology transfer approaches or even going as far as to work on university-industry technology transfer in real life, students are confronted with adapting to new information. Researching a case might enable students to incorporate a broad range of information sources and feedback loops. Thereby proposed solutions and recommendations might be evaluated with practitioners, experts but also documentation, questionnaires and observations. Solutions should be the result of an in-depth study which often requires a process of adaptation.

Reflection

The fourth design principle is structured reflection (R) because students should learn that the process that leads to the solution requires stepping back from experience even while still being amidst the cognitive processes. Although every case on university-industry technology transfer might be unique to some degree, similarities might be found that might transform experience into learning.

Table 10.1 provides some relevant background material and gives an overview of the four general design principles, namely problem definition, real-worldness, execution and reflection. One of the most important aspects of coaching and giving feedback is that it is the input to stimulate reflection.

Perusso et al. (2020) show that three types of reflection can be distinguished, namely reflection-in-action, reflection-on-action and critical reflection. Reflection-in-action requires students to re-think the rules, facts and theories and invent and experiment their new understanding during the experiential learning project. The coaching teacher might raise inconsistencies during the interaction and suggest new directions thereby creating an active learning situation that stimulates reflection and development of competencies. Reflection-on-action considers what happened during the execution but discusses the experiences after it happened. The coaching teacher helps students to move beyond the intuitive actions that have been taken and develop competencies by understanding the behavior and considering alternative behaviors that might be more effective. Finally, critical reflection focusses student's attention on personal and hidden assumptions and aims to stimulate thinking how personal influences shape experiences. These forms of reflection and learning require input. Feedback and coaching are something that a teacher can directly control and can take into consideration while designing the educational context. In addition, we recognize three general design principles while considering an experiential learning environment aimed at thinking about university-industry technology transfer.

These denominators are derived from the literature on experiential learning (Table 10.1). They represent a set of design principles that can be followed in educational programs to help the student (re)construct a business problem in experiential learning settings. These design principles enable the students to develop a particular way of understanding university-industry technology transfer. The design principles have been used in the exploration of digital tools and their contribution to learning from experience.

Table 10.1 Summary of design principle to enable implementation of university-industry technology transfer education

Design principle	Implications for case-study education on university-industry technology transfer	Relevant background
1. Real-world context (RW)	Cases need to reflect real scientific, entrepreneurial, corporate and governmental challenges and therefore case-driven research projects must allow and even enable interaction with scientists, entrepreneurs, corporations and governmental agencies. Such a context facilitates students in observation of practitioners' daily routines, strategies and manners enabling insights about the influence of elements such as uncertainty, pressure, moral judgments and risk. Thereby the case discussion with the class allows to take the workplace dynamics into the discussion.	Carriger (2015)
2. Determination of the problem boundaries (often ill-defined) (IDP)	The real world situation of university-industry technology transfer is complex, unstructured and the boundaries of science, business and innovation are often unclear, therefore case-driven research projects must allow students to practice with demarcating case-driven projects into concepts that are relevant and can be "tested." Such a context stimulates active learning by students because clear conceptual demarcation, consistency and accurate measurement with relevant data require more than a straightforward application of theoretical models.	Kilbane et al. (2004) and Gosling and Mintzberg (2006)

(*continued*)

Table 10.1 (continued)

Design principle	Implications for case-study education on university-industry technology transfer	Relevant background
3. Execution (E)	Execution of university-industry technology transfer is often hindered by lack or abundance of data, therefore case-driven research projects must allow students to become acquainted with using and organizing feedback loops. Such an interaction context with teachers, industry experts and fellow students stimulates incorporation of criteria for the (proposed) solutions that meet all actors perspectives thereby stimulating design thinking and perspective taking. In addition, through dialogue students are confronted with validity of the criteria and generalizability of their outcomes.	Farashahi and Tajeddin (2018)
4. Reflection (R)	The results of execution in a complex, ill-defined real-world context impacts multiple aspects of university-industry technology transfer therefore reflection is an important competency. Case-driven research projects must allow and even enable practicing the use and development of structured reflection mechanisms for example stimulated through embedment of in-action, on-action and critical reflection. Including such generic reflection mechanisms extends learning beyond the (re)solution of the case and enables professional development of group and individuals	Grey (2004 and Gosling and Mintzberg (2006)

Experiential Learning in SBI Bachelor's and Master's Programs

Many of the SBI bachelor's and master's programs at the VU are based on experiential learning. Table 10.2 shows an analysis of the four elements in courses in the bachelor's and master's programs involving real-world cases and how they facilitate experiential learning. In the following paragraph, the table will be discussed per analytical category of real-worldness, ill-defined problems, execution and reflection. In this context, the use of digital tools will be explained and evaluated.

Real-World Context

Students choose cases based on real-world innovations and problems with valorization. Teachers make sure the cases are embedded in the real world. In the innovation projects in the bachelor's program, for example, guest lectures with professionals are organized. Students interview potential customers. Students both in the bachelor's and in the master's programs do internships in R&D departments of companies in order to gain first-hand experience with the conversion of science into commercial application through innovation. Real-worldness is an aspect of cases chosen in the more advanced courses, toward the end of the bachelor's program and in the master's program. The didactical choice here is that the further the students get into the program, the more they need to be prepared for the world of work. Especially in the innovation projects, this becomes manifest.

Real-worldness is a crucial element of these projects. For example, in the Innovation Project Energy, students work on a problem from a large-scale commercial company in the energy sector and develop, in close consultation with a professional, recommendations related to smart grid solutions. In the innovation project health and diagnostics students work on a case provided by an early-stage academic entrepreneur. Such entrepreneurs often ran into challenges with the business side of the idea. Students collaborate with the entrepreneur to understand the fundamental scientific knowledge and work to develop the business side of the idea,

Table 10.2 Design principles of experiential learning in SBI bachelor's and master's program courses

	Course name (bachelor or master, year, period)	Short course description	RW?	IDP?	E?	R?
Bachelor's program	Essentials of Science, Business and innovation (B-Y1-P1)	General theoretical introduction of natural science driven innovation, and application of on self-defined "innovation X project"			✓	
	Innovation project medicine (B-Y1-P3)	Acquiring knowledge and insight into the development process of new medicines by working on the drug development trajectory for a predefined illness			✓	✓
	Entrepreneurship and innovation (B-Y1-P5)	Basic knowledge about entrepreneurship by comparing four cases that analyze the opportunity, entrepreneur, development process and the role of resources and environment.			✓	✓
	Innovation project energy (B-Y1-P6)	Work as an *intrapreneurial* team developing criteria for science-based opportunities by talking to the innovation manager of an energy company, then evaluating and developing ideas and finally pitching the idea to the innovation manager.	✓		✓	✓
	Innovation project health and diagnostics (B-Y2-P3)	Work as an entrepreneurial team on a natural-science-based idea, developing SB-criteria for evaluating elements of the project context and finally poster pitching the best idea.			✓	✓

(*continued*)

Table 10.2 (continued)

	Course name (bachelor or master, year, period)	Short course description	RW?	IDP?	E?	R?
	Innovation project alternative fuels (B-Y2-P6)	Explore an alternative fuels and related technologies in relation to economic, business and innovation context by analysing specific transition context, conducting scenario planning assignments and presenting value chains with entrepreneurial opportunities.	✓	✓		✓
	SBI bachelor's project (B-Y3-P4, P5 and P6)	Students conduct an independent small research project within a company including *defining* the value of the project context in relation to the relevant SBI elements, *designing* the project to reach academically valid research results and *executing* project consisting of data acquisition and pitching the results.	✓	✓	✓	✓
Master's program	Science project (M-Y1-P4 and P5)	Methodological design and execution of a research project on R&D from both a science, business and innovation perspective.		✓	✓	✓
	SBI Project & master thesis (M-Y2-P3, P4, P5, and P6)	Independent research project consisting of an internship in an organization, the formulation of an SBI-related problem, an analysis of this problem and written and oral reporting of the problem and analysis.	✓	✓	✓	✓

consisting amongst others of interviewing potential customers. In the Project Alternative Fuels they for the first time are challenged to take a more conceptual approach to a problem of science to business conversion via innovation, meaning that the students start from the abstract conceptual stage of the experiential learning cycle. This real-worldness in this context is that students have to gain knowledge about the alternative fuel in the real world before being able to start on the project. Digital tools play an essential role to facilitate real-worldness in the innovation projects, by, for example, enabling students to conduct interviews or to watch guest lectures. Moreover, the possibility of digitally providing lectures lowers the threshold for guest lectures. This is mainly because digital lectures do not put a time strain on the schedule due to travel requirements, whereas real-life lectures do.

Finally, the SBI bachelor's project is an internship of four months through which students experience first-hand and in actual work situation the drivers and barriers in moving from left to right in the innovation chain.

In the master's program, the science project and the SBI master's project, in which respectively internships are optional and obligatory, a real-world context is crucial for approval and successful development of the project. The level of these courses is advanced, and the ultimate goal is to have students develop a scientific research paper that is relevant for industry as well.

Whereas both bachelor's and master's students before did an internship to gain the real experience, they now take part in digital Teams and Zoom meetings. They go through a different, but valuable trajectory—developing more autonomy, self-confidence and a way to relate to people via digital means—which is a wholly different skill than the usual personal encounters and networking within a real-life internship context. At the same time, less personal encounters also mean that students are limited in the extent to develop interpersonal competencies such professional communications. The didactic implication is that a balance needs to be struck between solely digital and real-life context in order to create a meaningful learning experience.

Ill-Defined Problems

Management problems are not clear-cut. Reality is messy and unstructured. To carve out a case in a particular stage of the innovation chain, the problem first needs to be defined. What is the topic? Here especially the relevance of experiential learning becomes clear. A case is based on IDP but needs to be defined based on the SBI approach to decrease the extent to which it is “ill defined”. The case needs to be defined based on searches on the web, enhancing the digital literacy of students.

Then the research topic and research question need to be defined. This is different from direct questions of professionals. It needs a translation to a topic related to known problems in the translation from science to business through innovation. In the innovation projects, the case concerns technology. The Innovation Project Energy can be considered in terms of an intrapreneurship context. The company in question has a technological base focused on charging electronic cars and work on balancing the electric grid. Students are stimulated to think like business developers. They are provided with insights and data about the products, services and company and can interview the innovation manager about their opportunities. The interview contributes to the demarcation of criteria and subsequently, students make an analysis and provided substantiation with documents and calculations. The process is linear. The context of Innovation Project Diagnostics and Health is that of the early-stage academic entrepreneur. To guide the process, students use a weekly action research methodology formulating hypotheses, gathering data and testing them. The process starts with a fundamental science idea but subsequently moves iteratively between awareness of problems and developing potential solutions, toward advice.

During the project, students conduct at least five interviews and further substantiation takes place with documents and calculations. The entrepreneurs often mention that both the interaction and the advice provide ample inspiration to move in new directions. In both the Innovation Project Energy and the Innovation Project Diagnostics and Health students start with experiences and input from an expert and subsequently need to reflect, conceptualize and experiment. In other words, students can ask expert advice about the problem boundaries. The Innovation Project Alternative Fuels however requires a higher degree of independence in defining the case itself. Students first work on understanding the transition toward alternative fuels by, among others, analyzing science and market dynamics and in the final stage develop and evaluate opportunities. What we observe is that an experiential, case-driven project can start at different stages of the learning cycle.

At a master's level, the case is defined in a broader sense. The case can be how a certain decision-making process works, for example. That decision-making process needs to be conceptualized based on what we know from the scientific literature on decision-making. This is a core element of both the science as well as the master's project in the master's SBI.

Defining the problems requires interaction and instead of real-life interactions, students now use digital tools to facilitate the interaction for example through digital Teams and Zoom meetings. However, digital communications are mentally straining therefore students are more often required to provide small summaries or questions in advance. This approach enables short and meaningful conversations about ill-defined problems, for example, with coaches, entrepreneurs and industry experts. In didactical terms, it requires students to be more active in defining the problem before an interaction can lead to a meaningful conversation and creates a learning experience that helps students move beyond the ill-defined boundaries of the problem.

Execution

From the bachelor's to the master's program the independent execution of case-driven research projects and incorporation of information from industry experts slowly increases. The early bachelor courses (Essentials of Science, Business & Innovation (ESBI), Innovation Project Medicines (IPG), and Entrepreneurship & Innovation (O&I)) focus on developing an active learning attitude and collaboration competencies through the execution of group assignments. For example, in the course Essentials of Science, Business, Innovation students choose a case to research on a very rudimentary level the extent to which technology has commercial viability, thereby stimulating an active learning attitude. This is followed by the Innovation Project Medicine which aims to develop collaboration competencies. SBI students are required to collaborate with pharmaceutical science students in the group assignment. Group coaching focuses on tasks and supporting collaboration. Lectures treat the topics that should be addressed in the assignments and contain relevant knowledge to carry out the assignments. The interaction with industry experts has only limited consequences for the assignments. They mostly function as a source of inspiration. Information to substantiate evaluations and conclusions is mainly based on websites and documents. During these projects students get acquainted with moving through the four stages of the experiential learning cycle.

In the next courses (Innovation Project Energy (IPE), Innovation Project Diagnostics & Health (IDG) and Innovation Project Alternative Fuels (IAF)) a homogeneous group of SBI students works on assignments that require more independence in defining the project criteria. Lectures support the execution of the assignments by highlighting the topics that should be addressed. However, the amount of knowledge provided decreases per lecture. The data gathered via interviews should be included to support evaluations and conclusions by the students. In part, this is possible because students have had a research methodology course that introduces terms such as validity. Students have more freedom to experiment with what type of experiences they find meaningful to learn from. Group coaching shifts from tasks and support for collaboration toward a focus on process suggestions and creative problem-solution feedback. However, the support during execution is still mandatory and follows a week-by-week schedule. The goal of these meetings is to support the reflection and support in formulating potential learning goals.

Analyzing the execution with digital tools highlights the importance of body language (or lack thereof) and improvization. For example, the process of group coaching requires that the teacher takes more control over and directs the conversation because otherwise, students are hesitant to participate. Another example is the online defense. Seeing mostly faces only makes it more difficult to assess the use of other non-verbal communication. Students however improvise quite easily with the use of digital tools, thereby creating experiences upon which they can draw in their professional work—for example, on how to work together online, as a team. Moreover, the students also learn how collaboration can be facilitated with digital tools thereby preparing them to some extent in becoming "digital nomads".

The bachelor's, science and master's projects do not contain mandatory meetings that provide room to discuss feedback and process on an individual level. This contrasts with courses like the Innovation Project Energy, the Innovation Project Diagnostics & Health and the Innovation Project Alternative Fuels. Students have a high degree of independence and responsibility in the execution of these research projects. Assignments are still used to create an opportunity for providing feedback and there are some supporting lectures. However, the main goal of the lectures is to introduce a moment for questions about the assignments, share insights into research projects and support each other in creative problem-solving. Especially in the master's project the development of a professional skill-set is important and tested.

An interesting point in the innovation projects in the bachelor's and master's program is the group composition. In the innovation projects, the group composition is mixed with students from different study programs. The goal is to develop collaboration competencies while executing a project, while in other courses, mostly on the master's level, the different disciplinary backgrounds are used to guide the approach of the group for example via the division of tasks among the students. Both projects provide students with experience in working with people from different disciplines. Especially at the master's level, this creates an experience wherein SBI students learn that they are able and perhaps responsible for leveraging the multi-disciplinary backgrounds from all team members to produce viable advice.

A red thread throughout the bachelor's and master's courses is that increasingly, the autonomy of students is stimulated. Students need to find a balance between the wishes of companies on the one side, and academic requirements on the other. On an increasing practice- and theory-informed basis, students practice with developing evidence-based recommendations and entrepreneurial strategies and thus develop a personal toolkit of knowledge, skills and attitude on the level of execution.

Reflection

Both in the bachelor's and the master's programs, the three forms of reflection discussed are implemented. Reflection is fundamental to learn from the experience. During the innovation projects, reflection-in-action happens during the coaching session with the teacher. Especially in the beginning of the bachelor's and master's, students seem to require an acquaintance period to familiarize themselves with re-thinking the rules, facts and theories. Getting familiar with and actively drawing upon the topics is a first step toward conducting, inventing and experimenting with case-driven research projects. In part actively reflecting in-action could be considered an exercise of creativity, because it draws upon the fundamental knowledge of the learner. This does not mean that at a later stage inconsistencies and suggestions for new directions can be raised by the teacher.

Beyond this first stage, reflection-on-action becomes more important as the interaction with the teacher shifts from specific tasks topics initiated by the teacher toward process and execution challenges that draw upon teachers' execution experience. Reflection-on-action is implemented and stimulated through coaching by the teacher, a review by peer feedback or a business pitch. This happens for example in the innovation projects, in which, through weekly group meetings, it is considered if the goals have been achieved and to what extent a different strategy might be used. Another stimulus to activate reflection-on-action is peer feedback. Receiving feedback from other groups raises questions about the criteria used and the sources that substantiate them. The same reflection could be achieved through a business pitch. Reflection-on-action during the bachelor's project, science project, and master's project are facilitated—but only when students ask. Often teachers consider such meetings as an exercise of creativity. By highlighting some alternative paths, students are stimulated to rethink their basic assumptions.

Critical reflection is embedded in several courses via writing assignments and interactions. For example the Innovation Projects students first give and receive feedback from other students on a competencies level. Then they analyze the peer feedback and present a summary to the group under supervision of a teacher. Group members have the possibility to provide additional explanation or suggestions. The teacher can suggest alternative interpretations of the feedback and support in the reflection by highlighting alternative competency developments approaches. After the meeting students write a short reflection report which provides an action plan for further development. Critical reflection is also part of the bachelor's and master's project. Reflection is on the internship experience is the last step before graduating. Reflection is an important part of the work execution grade in the SBI master's project.

Digital tools play an important facilitating and supporting role in several of the innovation projects. Digital tools facilitate engagement by (1) providing short pre-recorded lectures enabling critical thinking and preparation before the lectures and (2) support students in peer-review of group assignments. Especially peer-review is important because it supports and stimulates students to understand and learn other cases by reviewing other students work. Furthermore, digital tools support meaningful student development through (1) individual group member evaluation on entrepreneurial competences which subsequently (2) facilitates a group discussion supervised by a teacher. This two-step reflection eventually stimulates a more critical reflection enabling the creation of a thoughtful plan of action. Didactic implication is that digital tools enable *individual* students to think actively about their entrepreneurial competences. The tools also enable *social* embeddedness of the learning activity.

Through the bachelor's and master's program, reflection is fundamental activity in learning from the experience and for guiding further experimentation. As students become more acquainted with the steps from the experiential learning cycle the implemented forms of reflection shift to more advanced levels, providing a higher degree of independence. Digital tools facilitate and mediate this process via activating students and making them aware of the social context in which they perform such reflection.

Conclusion

All four elements of experiential learning come back in both the bachelor's and master's programs. Real-worldness is stimulated by interaction with professionals, guest lectures and real consultancy assignments. Students translate ill-defined problems into cases that they can research, thus transgressing from ill-defined to defined "SBI" problems. Execution is part of their assignments, mostly during their internships. Reflection is mostly included as a means for the development of entrepreneurial skills and attitudes.

The use of experiential learning techniques, enhanced by digital technology, stimulates critical thinking on the relation between theoretical concepts and real management problems in SBEE. At the same time, it offers students some and an increasing degree of freedom, for example in choosing the theoretical approach. It helps them to define the problem and make use of the scientific literature in order to act evidence-based as entrepreneurs. This enables students to consult with companies on the chosen research approach, such as to ensure that the results provide relevant and useful outcomes. Methodology should support students, business and academics to co-create a relevant and meaningful research project. Experiential learning via digital technology is a form of learning that activates students to actively re-think and to help them build the bridge between university and industry.

This chapter shows that digital tools can be used to play a role in facilitating engagement and meaningful student development, thereby enabling students to move through the steps of the experiential learning cycle both a case content level and an individual competences level. Via digital tools the real-world experience can be at least partly replicated. Further research is needed on how digital tools may more effectively used in order to convey the real-world experience in such a way that the learning effect in this type of education, in which experiential learning is key, is optimized.

Learning Points

1. Experiential learning can be facilitated by taking into account the four building blocks: 1. real-worldness, 2. ill-defined problems, 3. execution, 4. reflection.
2. Building blocks in the courses that make up for the program in a balanced and sophisticated manner (and thus: not randomly).
3. When implemented as a learning tool in science- and technology-based entrepreneurship education programs, digital tools assist in conveying the real-world experience to students via guest lectures, interviews and interactions with representatives from industries.
4. And enables students to draw lessons from these experiences that are relevant to practice, while at the same time containing academic relevance as well.

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