USING THE INQUIRY-BASED LEARNING APPROACH TO ENHANCE STUDENT INNOVATIVENESS: A CONCEPTUAL MODEL

Oguz A. Acar
Cass Business School
City, University of London
Email: oguz.acar@city.ac.uk
Phone: +44 (0)20 7040 8592
Address: 106 Bunhill Row, London EC1Y 8TZ, UK

Aybars Tuncdogan
King's College London
Email: aybars.tuncdogan@kcl.ac.uk
Phone: +44 (0)74 5914 1258
Address: 30 Aldwych, London WC2B 4BG

Forthcoming in Teaching in Higher Education

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ABSTRACT

Individual innovativeness has become one of the most important employability skills for university graduates. In this paper, we focus on how students could be better prepared to be innovative in the workplace, and we argue that inquiry-based learning (IBL) – a pedagogical approach in which students follow the inquiry-based processes used by scientists to construct knowledge – can be effective for this purpose. Drawing on research which examines the social and cognitive micro-foundations of innovative behaviour, we develop a conceptual model that links IBL and student innovativeness, and introduce three teacher-controlled design elements that can influence the strength of this relationship, namely whether an inquiry is open or closed, discovery-focused or information focused and individual or team-based. We argue that an open, discovery-focused and team-based inquiry offers the greatest potential for enhancing students' skills in innovation. This paper has several implications for higher education research and practice.

Keywords: *innovation; inquiry-based learning; teaching practice; employability*

INTRODUCTION

Innovation – the process of creating novel ideas and transforming them into new products, services and processes – is widely considered to be one of the main drivers of competitive advantage and organizational performance (e.g., Camisón & Villar-López, 2014; Crossan & Apaydin, 2010). It is therefore not surprising that employers want people who can contribute to organizational innovativeness by, for example, coming up with and effectively implementing creative ideas for new products, novel ways of responding to external demands, or solutions to challenging innovation problems (e.g., Korthagen, 2006; Shalley & Gilson, 2004; Stierand, 2015; Yuan & Woodman, 2010). A recent report from the World Economic Forum, entitled *The Future of Jobs*, demonstrates clearly that, throughout the world, organizations in different industries have a need for innovative skills (WEF, 2016). It also predicts that such skills will grow in importance in the near future given the disruptive nature of changes we experience today – ranging from the internet-of-things to 3D printing and artificial intelligence. Being able to solve novel problems and to come up with new ideas are predicted to be two of the most important skills needed by 2020. Given the growing emphasis on increasing graduate employability (e.g., Bridgstock, 2009; Tomlinson, 2012), higher education institutions have a strong interest in facilitating students to develop skills to enable them to innovate[1].

However, despite broad agreement among educators, researchers and practitioners on the importance of innovation, our knowledge on the pedagogical approaches and learning tools that can enhance students' innovativeness – i.e., "the development of novel, useful ideas

[1] It is worth noting that higher education institutions have several (and arguably more important) purposes beyond the development of graduate employability skills. Our argument here is that graduate employability is one of the purposes of higher education institutions (i.e., it is neither the sole nor the most essential purpose of higher education) and is becoming increasingly important. To illustrate, in many countries (e.g., UK, Australia and Canada), public funding for higher education institutions relies partially on the employment rates of graduates (e.g., Bridgstock, 2009; Tomlinson, 2012).

and their implementation" (Baer, 2012, p.1102) – is limited. Educators would therefore benefit from engaging in a deeper discussion of the pedagogical methods that can help students to become more innovative. This paper is a step in that direction and aims to examine how university students could be better prepared for the innovation-related demands they will experience in the workplace. More specifically, we build a straightforward conceptual model which builds on and integrates education research on inquiry-based learning (IBL), and behavioural research on innovation. That is, our model examines how IBL, a potentially valuable pedagogical approach, can drive and develop student innovativeness. It also identifies three teacher-controlled design elements, namely whether an inquiry is open or closed, discovery-focused or information focused and individual or team-based, that we argue will affect the strength of the relationship between IBL and student innovativeness. In particular, we theorize how these factors have different impacts on cognitive and social processes of innovation (and in turn student innovativeness). We suggest that the positive effects of IBL on student innovativeness are greater in open, discovery-focused and team-based inquiries.

Our conceptual model has important implications for the literature on IBL. Although the potential of IBL for enhancing students' learning, performance, academic skill development, and personal experiences has been highlighted in earlier studies (Aditomo, Goodyear, Bliuc, & Ellis, 2011; Ellis, Goodyear, Brillant, & Prosser, 2008; Hmelo-Silver, Duncan, & Chinn, 2007; Justice, Warry, & Rice, 2009; Lazonder & Harmsen, 2016), we are unaware of any research that has examined the potential benefits of IBL for student innovativeness. In addition, it has been noted in the higher education literature that there has been limited research on the different ways in which IBL may be undertaken (e.g., Aditomo et al., 2013; Goodyear et al., 2013). Our model addresses this by identifying how an inquiry can be designed in different ways and explaining how these types of inquiries have different

impacts on the cognitive processes that students engage in. This helps to provide a better understanding of both the effects of IBL and the teacher-controlled design elements that can affect its effectiveness. We also develop a brief research agenda, which we hope will help to invigorate the discussion in education journals on student innovativeness in general and on the role of IBL in stimulating and developing student innovativeness, in particular.

THEORETICAL BACKGROUND

Inquiry-Based Learning

There is no universally accepted definition of IBL and a number of different conceptualizations of IBL were developed in the education literature. After all, not only IBL itself has quite a long history (See Arends, 2014), but it also is a tradition that has benefited from a range of prior and/or co-existing streams of literature, such as the ones on experiential learning (e.g., Kolb & Kolb, 2005) and reflection (e.g., Boud, Keogh & Walker, 2013). However, if we simply focus on the common ground for the purposes of this paper, IBL could be defined as a pedagogical approach in which students follow the inquiry-based processes to construct knowledge (e.g., Keselman, 2003; Lazonder & Harmsen, 2016). A typical inquiry consists of five main stages: *orientation* (i.e., familiarization with the area of inquiry), *conceptualization* (i.e., generation of questions and hypotheses), *investigation* (i.e., collection and interpretation of information), *conclusion* (i.e., drawing conclusions and/or providing solutions based on the investigation), and *discussion* (i.e., communicating and reflecting on the conclusion) (Pedaste et al., 2015). Inquiry-based learning is sometimes referred to as problem-based learning (PBL), an approach in which a scientific inquiry starts with a real-world problem. Scholars have noted that the difference in terminology comes mainly from how these two approaches originated – the term PBL is often used in the context

of medical education whereas IBL is the term used in most other disciplines – and that the two approaches are indistinguishable in practice (Aditomo et al., 2011; Hmelo-Silver et al., 2007).

IBL emphasizes the central role and responsibility of students in the learning process. That is, in IBL, control of the learning process does not rest with the teacher, but students are considered to be active contributors in the process. As such, IBL is founded on a student-centered and self-directed approach to learning (Spronken-Smith & Walker, 2010). Student-centered learning is a pedagogical approach that stresses the responsibility of students in the learning process, rather than the activities of teachers (Cannon & Newble, 2000). Likewise, self-directed learning has been described as "*a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes"* (Knowles, 1975: 18).

Inquiry-based learning is also closely related to two other educational philosophies that are broader in scope: active learning and experiential learning. Active learning refers to approaches in which students are considered to be active participants in the learning process and which focus on activities that engage students in that process (Bell & Kozlowski, 2008; Prince, 2004). The process of IBL is one that relies mainly on active engagement from students; however, active learning also includes a wide range of other activities (e.g., in-class games and activities). The second philosophy, experiential learning, highlights the importance of hands-on experience in the learning process (Kolb, 1984). In this approach, learning comes from grasping and transforming an experience into knowledge (Kayes, 2002; Kolb & Kolb, 2005; Ng, Van Dyne & Ang, 2009). The learning process in IBL is experiential

in nature (i.e., students learn from experiences during an inquiry), but experiential learning encompasses a broader set of activities – it includes activities that go beyond those of IBL.

Prior research on IBL focused predominantly on how it relates the retention and transfer of what has been learnt, performance in subsequent tasks, development of academic skills and students' personal experiences of the learning process (Aditomo et al., 2013; Ellis et al., 2008; Hmelo-Silver et al., 2007; Justice et al., 2009; Lazonder & Harmsen, 2016). Clearly, this line of research has enhanced our understanding of some of the key advantages of taking an IBL approach. However, the potential benefits of IBL are not limited to those identified in prior research. In this paper, we add to the on-going dialogue in the literature by exploring the link between IBL and student innovativeness.

Inquiry-Based Learning and Innovativeness

There are two key aspects to individual innovativeness in organizations. One is the generation of creative (by which we mean both novel *and* useful) ideas for products, services, strategy or processes (i.e., ways of doing things); the second is implementation – putting those creative ideas to work (Baer, 2012; Yuan & Woodman, 2010). The first involves activities that relate to the recognition of a problem or opportunity, the search for relevant information from a wide variety of sources, and the generation of ideas and solutions to address the problem (Zhang & Bartol, 2010a). The second relates mainly to activities such as pitching a creative idea and bringing others on board so that the necessary support and resources can be secured to implement the idea (e.g., Mørk, Hoholm, Ellingsen, Edwin, & Aanestad, 2010). It is worth stressing here that although innovativeness and creativity are concepts that are closely related, they are not the same thing. This is because innovation has not only a creativity component, but also an implementation component, and creativity can be

considered as the beginning stage of innovation (e.g., Baer, 2012; Somech & Drach-Zahavy, 2013).

For two reasons, we believe that an inquiry-based learning approach is helpful in terms of improving students' skills in creating and implementing new ideas. First, IBL contributes to creation of an appropriate learning environment for engaging students in innovative behaviours. Because innovation requires independent and original thinking, a sense of autonomy, and a personal initiative (e.g., Baer & Frese, 2003; Scott & Bruce, 1994; Yuan & Woodman, 2010), IBL, with its emphasis on self-direction, is well suited to training students to become innovative. A recent meta-analysis of 191 independent samples, for example, demonstrated that individuals are more likely to come up with novel and useful ideas when they have freedom to determine how they carry out their tasks (Liu, Jiang, Shalley, Keem, & Zhou, 2016). This cannot be achieved using a traditional teaching approach in which students are lectured *at* and seen merely as passive recipients of knowledge. Unlike IBL, an approach of this kind does not train students to be innovative as it inhibits their independence and flexibility (Bell & Kozlowski, 2008; Lea, Stephenson & Troy, 2003). To sum up, as an approach that promotes self-directed learning, IBL offers a very promising way of preparing students for the innovation-related demands of organizations today.

Second, the learning process in IBL strongly resembles the actual processes of innovation. With its focus on finding answers to problems, the learning process in IBL is very similar to the innovation process in companies, which is often triggered by the recognition of a problem or opportunity (Kanter, 1988). Likewise, the activities undertaken to solve a problem are similar to those used in organizational innovation projects. In both cases, there is heavy reliance on, for example, exploring information from diverse sources, generating multiple ideas to solve problems, assessing thoroughly which ideas are viable and

communicating effectively what the best solution might be. Such similarities allow students to gain essential practical experience in processes used in innovation such as those listed above. This is likely to help them to develop knowledge and transferable skills that are essential for enabling them to perform better in innovation-related activities as well as in other contexts (Singley & Anderson, 1989; Dokko, Wilk & Rothbard, 2009).

In addition, having practical experience relevant to the innovation process is likely to decrease the perceived risk of engaging in innovation. More specifically, any innovation carries at least two risks; the risk of the innovation itself (e.g., whether a novel product will be received positively by customers) and that of the innovation process (e.g., whether it will be possible to develop the novel product). We believe that having relevant experience will make the innovation process seem less risky. When students become more used to the uncertain and risky nature of innovation, they might be less fearful to engaging in it. In other words, gaining some familiarity with the types of processes that are part of innovation is likely to make students subsequently more amenable to undertaking innovation in an organizational context. Taken together, we propose that:

Proposition 1: Students who are exposed to the inquiry-based learning are more innovative in the workplace than those who are exposed only to conventional teaching approaches. That is, inquiry-based learning is positively related to student innovativeness.

Different Types of Inquiry-Based Learning

According to the IBL literature, inquiries differ in terms of the extent to which they are (a) open vs. closed, (b) information-focused vs. discovery-focused and (c) individual vs. team-based (Aditomo et al., 2011; Furtak et al., 2012). The 'openness' of an inquiry refers to the extent to which the learning process is self-directed or student-led (e.g., Healey, 2005; Levy

& Petrulis, 2012; Spronken-Smith & Walker 2010). In other words, an 'open inquiry' is an inquiry in which students experience the greatest level of self-direction as they identify both the problem and the ways of solving it. A 'closed inquiry', on the other hand, is one in which the teacher presents the problem and outlines how it can be solved. In other words, the teacher designs the route of the inquiry from the start – selecting the questions, the ways in which they will be tackled, and most of the conclusions that will be reached. Likewise, an inquiry can either be designed with the purpose of information acquisition or with the purpose of discovery (Healey & Jenkins, 2009; Levy & Petrulis, 2012). In a discovery-focused inquiry, the goal is to create something that is original (e.g., a new product design, action plan for a nonprofit project, or academic knowledge). In an information-focused inquiry, on the other hand, the purpose is to explore and acquire existing knowledge (e.g., review the literature or explore some type of organizational practice). Finally, IBL can be used on its own, or in combination with team-based learning. When IBL is undertaken in teams, it is sometimes referred to as team-based inquiry (Levy & Petrulis, 2012).

Open vs. Closed Inquiries. Whether an inquiry is open or a closed has important implications for student innovativeness, because it influences the type of innovative behaviours that students will engage in during the process. An open inquiry requires students to identify the problem themselves. It therefore requires a deep engagement with the very first step required in innovation – recognition of a problem, need or opportunity (Kanter, 1988). Engagement in problem identification (or problem construction) is not required in a closed inquiry as students are given a predefined problem to address. Prior research has shown that engagement in the problem identification process is associated with the generation of more novel solutions (e.g., Reiter-Palmon et al., 1997; Rostan, 1994; Zhang & Bartol, 2010). Naturally, by engaging in problem identification processes, students are likely to improve their problem identification skills and to become more innovative in the workplace

after they graduate. A series of studies with art students provided some indirect evidence of this: Csikszentmihalyi and colleagues found that the students' level of engagement with problem identification was linked not only to the originality of their subsequent paintings but also predicted their longer-term artistic success (Csikszentmihalyi, 1990; Getzels & Csikszentmihalyi, 1975; 1976). Problem identification skills are even more critical for the generation of novel solutions when problem-related information is diverse and inconsistent – for example, when one encounters information that is inconsistent with or contradicts prior knowledge (Reiter-Palmon et al., 1997). This is a common issue in the workplace today, given the ever-increasing levels of dynamism, complexity and uncertainty (e.g., Berman, 2010; Luoma, 2006). We therefore propose that:

Proposition 2a: An open inquiry strengthens the positive relationship between inquiry based-learning and student innovativeness such that students who are exposed to this type of approach are more innovative in the workplace than those who are exposed to either a closed approach or traditional teaching approaches.

Discovery-Focused vs. Information-Focused Inquiries. The purpose of an inquiry (i.e., whether it focuses on discovery or information acquisition) also has important implications in terms of what innovative behaviours students engage in during the inquiry. We argue that discovery-focused inquiries create a better learning environment for innovation than information-focused inquiries, because they emphasize the generation of new ideas, solutions or knowledge. The processes of generating alternative ideas and then selecting the best are central to individual innovation (Scott & Bruce, 1994; Yuan & Woodman, 2010). Engaging in such processes is therefore essential for developing students' innovativeness. It is worth noting that an information-focused inquiry can still contribute to innovativeness, in

that it stimulates the exploration of information from a variety of sources, which is also an important process for engendering innovative outcomes (Acar & van den Ende, 2016; Scott & Bruce, 2004; Zhang & Bartol, 2010). For example, drawing on secondary data from Thomson Scientific's High Impact Papers database, Schilling and Green (2011), found that when scientists cite articles from a variety of disciplines, they are more likely to make atypical associations between disciplines and in turn create high-impact articles. Information search is not unique to information-focused inquiries; it also forms part of discovery-focused inquiries. Since a discovery-focused inquiry involves not only exploring information from different sources but also using this information to generate novel solutions, we propose that:

Proposition 2b: A discovery-focused approach strengthens the positive relationship between inquiry-based learning and student innovativeness such that students who are exposed to this type of approach will be more innovative in the workplace than those who are exposed to either an information-focused approach or traditional teaching approaches.

Individual vs. Team Inquiries. The main advantage of an individual inquiry over a team inquiry is that it ensures the student is engaged in all the processes of the inquiry. The chief drawback, however, is that this does not entirely reflect the reality of the workplace where most innovation projects are based on teamwork and are highly influenced by interactions with colleagues (e.g., Griffith, 1999; Scott & Bruce, 1994). Apart from being closer to actual workplace procedures, working in teams also has the benefit of facilitating knowledge exchange between different students and exposing them to a wider variety of perspectives, especially when the team includes students from different backgrounds (e.g., Boni et al., 2009). This can help students to improve their ability to work collaboratively and to build on and integrate others' ideas – abilities that are considered to be important in

sparking innovation (Hill, Brandeau, Truelove & Lineback, 2014). Indeed, several meta-analyses showed that diversity in terms of functional and backgrounds is positively related to innovation (Bell, Villado, Lukasik, Belau, & Briggs, 2011; Hülsheger, Anderson, & Salgado, 2009; Van Dijk, Van Engen, & Van Knippenberg, 2012). Therefore, a team-based inquiry can provide better training for students, enabling them to experience the social processes involved in innovation.

Another social aspect of innovation concerns the implementation of ideas. As noted earlier, generating creative ideas is an important step early on in the process, but for innovation to come about, those ideas also need to be put to work. Within organizational settings, the implementation of innovation requires support and sponsorship from key stakeholders (Baer, 2012; Kanter, 1988; Mørk et al., 2010). In other words, in order for a creative idea to be implemented, the innovator needs to convince other people in the company of the idea's potential and gain support for it. Baer (2012) has, for instance, shown that networking ability and strong ties are required for the implementation of creative ideas based on a survey of 238 employees from a large global agricultural processing firm. Working in teams might also help develop those skills to some extent, as those in the team will need to convince fellow team members to go with their idea, rather than someone else's in the team. This brings us to our next proposition:

Proposition 2c: A team-based approach strengthens the positive relationship between inquiry based-learning and student innovativeness such that students who are exposed to this type of approach are more innovative in the workplace than those who are exposed to either an individual approach or traditional teaching approaches.

DISCUSSION AND CONCLUSION

In today's markets, organizations need employees who can deal with the unexpected and unfamiliar problems that frequently arise. Therefore, one goal of higher education has to be to prepare graduates for this turbulent environment by helping them gain the innovation-related skills needed to overcome such problems. In this paper, we have suggested that an inquiry which is open, discovery-focused and team-based could help to stimulate innovative behaviour in students and make them better equipped to meet the innovation-related demands of industry today.

Implications for Theory and Practice

This paper takes one of the first steps in addressing teaching methods that can have long-lasting positive effects on the innovativeness of university students. It thus helps to address one of the major criticisms of higher education – its relevance to real life problems. Indeed, higher education is often criticized as being somewhat disconnected from real-life problems (e.g., Iran-Nejad, 2013; Knights, 2008; Quaye & Harper, 2014). Given the importance of innovation-related capabilities for contemporary organizations, the approach proposed here can be one way to bridge the gap between higher education and practice. In particular, the use of innovation-focused inquiries that either reflect current organizational problems – or are indeed real organizational problems – can enhance the relevance of higher education. We are not only focusing on students' innovativeness in class, but emphasizing the positive effect that inquiry-based learning can have on their innovativeness in the longer term (i.e., after they graduate). We propose that inquiry-based learning is an effective pedagogical method to prepare students for organizational roles that make high demands in terms of innovation.

Our conceptual model has implications for the literature on inquiry-based learning. Although IBL is a well established pedagogical approach in higher education and its potential benefits in terms of student engagement are widely acknowledged, our knowledge of how IBL (and other alternative pedagogical approaches) can impact on student innovativeness is limited. We address this gap by developing a theoretical framework regarding how IBL is related to student innovativeness. Our model helps to clarify the differences in the implementation of IBL by distinguishing between the different types of inquiry and theorizing how these types relate to the cognitive and social processes that are essential for student innovativeness. As such, we identify conditions under which IBL might better facilitate the development of innovative skills, and introduce three teacher-controlled design elements that can amplify the strength of the link between IBL and innovativeness. Our theory therefore provides insights regarding the best ways of using inquiry-based learning, which we believe will be useful from both a theoretical and practical standpoint.

Future Research Directions

The natural next step after this conceptual study will be empirical testing. Future empirical research could use our conceptual model as a starting point for examining teaching methods that can increase student innovativeness in the long term. We believe two issues are important in testing our model. First, the research designs will have to be longitudinal. This is because, if our purpose is to prepare students for the realities of organizations today, we have to make sure that their innovativeness is increased not only while they are taking a course module, but also after they leave. Likewise, longitudinal designs will be necessary to determine how long an exposure is needed for the effects to occur, and how long these effects last after graduation. Second, as we have already discussed in this paper, there are various

ways in which inquiry-based learning approach can be employed in the classroom. As a result, testing even the main effect requires either well thought-out field experiments or at least large archival studies involving participation by multiple institutions. Despite the substantial research investment required to test the effects of this teaching approach, we believe that if the approach actually turns out to increase student innovativeness after graduation, the investment would be well justified. However, if it does not, this stream of research is still likely to result in the discovery of another method that does.

Our model is only a first step, and certainly has significant room for further development. We have focused our efforts on teacher-controlled design elements that can influence the effectiveness of IBL on innovativeness, and this was motivated by our aim to generate insights that would be immediately usable by practitioners. Clearly, there are other important factors that are not teacher-controlled or related directly to the design of an inquiry but can still influence the effectiveness of IBL and/or determine which type is most appropriate. That is, giving consideration to significant psychological factors as well as to the characteristics of the learning environment could be key for maximizing the benefits of IBL.

Given that IBL is a strongly student-centred approach, differences between students (e.g., in terms of their ability or experience) are essential in determining the effectiveness of various forms of IBL. One group of psychological factors which may affect the effectiveness of IBL concerns traits and trait-like individual differences between students (e.g., Bache & Hayton, 2012; Chen, 2014; Maclellan, 2015; Ortega-Maldonado & Salanova, 2018). For example, the cognitive abilities of the student group, such as their general intelligence, attention span and skills in verbal articulation, cultural background and age can be important factors. Recent research suggests that people with lower cognitive abilities require more structure, because unstructured exploration might increase the cognitive workload to a level

that they find unmanageable (Bell & Kozlowski, 2008; Gully, Payne, Koles & Whiteman, 2002; Van Merriënboer, Kirschner & Kester, 2003). Therefore, types of inquiry that are cognitively more demanding (e.g., open and/or discovery-focused) might be more suitable for student groups with well-developed cognitive abilities. In a similar vein, students who have prior knowledge of the inquiry area might be more effective in undertaking cognitively demanding inquiry types. This is because such students can fully allocate their cognitive resources to unstructured exploration rather than spending some of their cognitive resources to familiarize themselves with the inquiry area (e.g., to learn the basics of the inquiry area, etc.). Future research should explore how different types of cognitive abilities affect the effectiveness of different types of inquiry.

Another important individual difference could be the students' educational background. Students whose educational background has brought them into contact only with traditional teaching methods may experience difficulty in embracing the responsibilities and challenges that inquiry-based learning brings. Active and self-directed learning can be a difficult and stressful process (Ryan, 1993; Simons & De Jong, 1992), and students may not be very comfortable about changing their learning style. The resultant negative emotions may hinder learning and performance (Kanfer & Ackerman, 1989), and this issue needs to be addressed in order to enhance the learning experience for all students. For example, an inquiry that is open and discovery-focused may become very uncertain and risky. As a result, students that are new to the IBL approach in particular may experience significant difficulties. These challenges should not be considered as something that is specific to IBL, as they are inherent in innovation processes as well. Communicating the rationale for such processes and the potential benefits for the students' subsequent employment might enhance student engagement and help to stave off negative feelings. Use of emotion-control strategies may also help students to feel more positive about innovation process. Researchers, for

example, have found that positive statements (e.g., “Remember, worry won’t help anything”, “This task may be challenging, but I know I can do it”) reduce the frequency of anxiety of trainees in an experiment with 350 undergraduate students in which they were trained to operate a complex computer-based simulation (Bell & Kozlowski, 2008). Hence, exploring the interaction between IBL and emotion-control strategies on innovativeness may be important, especially because incorporating such strategies within a module is quite easy and straightforward.

The individual differences of the teacher may also affect how the IBL is implemented (e.g., Chi, Yeh & Choum, 2013; Meijer, Geijsel, Kuijpers, Boei & Vrieling, 2016; Skourdoumbis & Gale, 2013). For instance, as IBL is a student-centered and self-directed learning approach, it will not work unless the teacher is willing and able to allow students to take over control of the learning process. Individuals who do not have physical and psychological traits associated with dominance (e.g., high testosterone levels and low agreeableness scores) may be more suited to the IBL approach, as they are likely to be more willing to delegate control. Likewise, traits of the teacher that affect overall academic, leadership and work performance, such as general and emotional intelligence (e.g., Cavazotte, Moreno & Hickmann, 2012; O'Boyle, Humphrey, Pollack, Hawver & Story, 2011; Tuncdogan, Acar & Stam, 2016), may also affect the effectiveness of IBL. This is partly because IBL, especially when it involves an open inquiry, requires the teacher to be able to draw interesting conclusions during the class, follow new lines of thought proposed by students, and also have a good comprehension of how, when, and how much to help each student. It is worth noting that although some of these individual differences are relatively stable over time (e.g., Solds & Vaillant, 1999; Tuncdogan, Acar & Stam, 2016), they may manifest themselves differently under different environmental conditions (e.g., interventions

such as professional development practices and feedback – for example, see the literature on situational strength, e.g., Meyer, Dalal & Hermida, 2010).

Yet another factor that is important for the effectiveness of the IBL approach is the assessment and feedback structure as this influence students' and teacher's approach to failure and errors (e.g., Raveaud, 2005). Innovation involves and even requires a great deal of trial and error, as uncertainty is a signature feature of the innovation process. Therefore penalizing 'smart' failures – those ideas that had a sound and convincing rationale but did not succeed – is likely to reduce the effectiveness of IBL. That is, under such conditions, students will tend to play it safe and avoid risk-taking, and this is detrimental to innovativeness. In addition, failure can be an important source of learning as long as the learner does not allow negative emotions to interfere with learning (Shepherd, 2004). To mitigate negative emotions that can arise in the event of failure, teachers could potentially use insights from earlier research which found that framing the error in a positive way with statements such as "errors are a positive part of the training process" and "you can learn from your mistakes and develop a better understanding" can improve adaptive performance – performance in activities that are different from what people have been trained to do (Bell & Kozlowski, 2008). Likewise, 'error management' training, a training where "participants are explicitly encouraged to make errors and learn from them" (Keith & Frese, 2005, p. 677), may contribute to success of IBL. Again, whether such trainings and verbal framing techniques would actually influence the long-term effectiveness of the IBL approach on student innovativeness is a question future research will need to address.

Finally, the choice of topic or subject for an inquiry may also be important in determining how effective it will be. More specifically, it is beneficial to have inquiries that reflect real-life problems as higher education institutions are increasingly interested in

developing graduate employability skills (e.g., Bridgstock, 2009; Tomlinson, 2012). To that end, using case studies that present students with a specific organizational issue or projects that require the creation of an innovative end-product and bringing practitioners into the classroom as part of the IBL process, can increase the relevance for students. Developing close connections with practitioners is also promising in terms of improving students' skills that relate to the implementation of innovation. For example, students can be presented with actual problems and work together with practitioners to put their solutions into practice. In cases where this is not feasible (e.g., when a course's timescale does not accommodate full-scale implementation of a solution), students may be asked to articulate the implementation steps in the form of a detailed plan. On a related note, leveraging digital technologies (e.g., utilizing simulations or design software to develop digital artefacts) could also enable students to improve innovative skills related to implementation. All in all, the question of which specific teaching tools and techniques can enhance the positive effects of IBL on student innovativeness requires further research attention.

To conclude, given the wide range of available teaching methods and the plethora of possible moderators, we believe that this area of pedagogical research richly deserves further attention in order to generate a better understanding of how innovativeness can be cultivated in students.

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