DESIGN THINKING: A SOURCE OF EMPOWERMENT AND LEARNING

Kristiana Roth, University of Applied Sciences Upper Austria, Austria
Christiane Rau, University of Applied Sciences Upper Austria, Austria
Dietfried Globocnik, Alpen-Adria University Klagenfurt, Austria
Anne-Katrin Neyer, Martin-Luther- University Halle-Wittenberg, Germany

ABSTRACT

A variety of top educational institutions has adopted design thinking approach in their entrepreneurship education curriculum. However, limited empirical evidence exists about its effectiveness. This paper critically examines whether design thinking indeed results in higher learning outcome and the underlying mechanisms behind this relationship. The study was conducted in the form of a field survey. Survey responses were collected from 160 students participating in real-life companies' projects that vary in their application level of design thinking practices. The results demonstrate a positive relationship between design thinking practices and learning outcomes in terms of acquisition of know-how and new skills. Furthermore, this relationship is fully mediated by psychological empowerment. This is one of the first studies providing empirical support for the effectiveness of design thinking in entrepreneurship education based on quantitative data. Furthermore, we deepen the understanding of the role psychological empowerment plays in design thinking, showing that it is not only a by-product but is in fact a key mechanism through which design thinking realizes its effects on learning.

INTRODUCTION

Despite the general consensus that entrepreneurship and entrepreneurial thinking can be taught and learned, the effectiveness of specific pedagogical approaches remains unclear (Von Kortzfleisch et al., 2013; Nian et al., 2014). There are strong arguments that entrepreneurship should be taught as a method, focusing on teaching students how to think, act, anticipate and create in an uncertain future (Neck & Greene, 2011). This can effectively be achieved through pedagogical approaches that let students experience entrepreneurship through an iterative and continuous process focused on understanding customers, interpreting existing knowledge and identifying opportunities (Kremel & Edman, 2019; Nabi et al., 2017; Von Kortzfleisch et al., 2013). One of such pedagogical approaches is design thinking - a human- centered approach to problem solving and innovation based on the interplay of exploration, iteration and prototyping. Following its wide adoption among business practitioners, design thinking has also been gaining traction in the entrepreneurship education (Nielsen & Stovang, 2015). Stanford Graduate School of Business with its d. school, University of Pennsylvania with its Innovation & Design Club and schools like INSEAD, London Business School, and Esade Business School are just a few prominent examples of institutions that provide design thinking courses. In fact, design thinking can already be found in the curriculum of 49 out of 50 Top MBA for entrepreneurship programs (Financial Times: Business Education, 2018). It is even used as an approach to entrepreneurship program development (Huq & Gilbert, 2017).

Citation Information: Roth, K., Rau, C., Globocnik, D., & Neyer, A.K. (2022). Design thinking: A source of empowerment andlearning. *Journal of Entrepreneurship Educaton, 25*(S3), 1-17.

The proponents of design thinking argue that the design process provides a valuable lens through which entrepreneurship students can learn to identify unique business opportunities (Neck & Greene, 2011). Divergent and convergent thinking, observation, synthesis, visualization, critical thinking and feedback loops that characterize the design process are also key components of an entrepreneurial journey. Therefore, introducing the design thinking approach to entrepreneurship education programs fosters students' skills and thinking patterns necessary to address complex entrepreneurial problems (Dunne & Martin, 2006; Garbuio et al., 2018) and build skills to identify and act on business opportunities (Neck & Greene, 2011).

However, empirical research on whether design thinking indeed creates these positive learning outcomes in entrepreneurship education is surprisingly scarce. There is evidence of a positive relationship between the application of design thinking practices and self-perceived improvement in collaboration skills, appreciation for teamwork, empathy and tolerance for ambiguity (Ungaretti et al., 2009; Lynch et al., 2021). Daniel (2016) finds that application of design thinking practices can positively affect the students' motivation and satisfaction with their performance. Nevertheless, the majority of these emerging empirical insights on design thinking in entrepreneurship education are based on anecdotal case studies rather than quantitative evidence. Consequently, we do not yet know whether integration of design thinking in entrepreneurship education is indeed effective and provides better learning outcomes despite the fact that almost all Top 50 MBA for entrepreneurship programs offer design thinking. Furthermore, to the best of our knowledge, existing literature has not examined the mechanisms underlying the relationship between design thinking and learning outcomes. Thus, this study aims to answer the following research question: Does design thinking result in higher learning outcomes, and if so, how?

We argue that the development of empowerment – a previously observed by-product of design thinking application in active learning classrooms (Mubin et al., 2017; Vanada, 2014) is a promising mechanism that could explain the creation of positive learning outcomes observed in practice. We draw on existing design thinking and psychological empowerment literature (Thomas & Velthouse, 1990; Spreitzer, 1995) which provides the foundation for our arguments. Design thinking practices such as user-focus, problem framing, prototyping and iteration based on gathered insights foster feelings of competence, meaning, self-determination and autonomy – the building blocks of psychological empowerment. Empowered students have higher motivation as they feel more competent in the classroom and find learning activities important and worthwhile (Frymier et al., 1996; Houser & Frymier, 2009). This feeling of competence to perform a meaningful task that creates an impact for themselves or the involved target groups helps students to produce higher-quality assignments and take responsibility for their learning (Sanders et al., 2011).

We test our theoretical model with empirical field survey data collected from 160 students participating in real life companies' projects that vary in their application level of design thinking practices. This study offers several contributions to the literature on the effectiveness of design thinking as pedagogy in entrepreneurship education. First, it adds new insights to the entrepreneurship education literature that has called for more research on the impacts of specific pedagogical interventions, especially experiential pedagogies and competence model-related pedagogical methods (Nian et al., 2014; Nabi et al., 2017). It is one of the first studies quantitatively assessing the impacts design thinking creates in entrepreneurship education. Second, following the call for higher use of impact indicators related to emotions and mindset (Nabi et al., 2017), we highlight the crucial mediating role of psychological empowerment in

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achieving better learning outcomes. Including this motivational construct that reflects students' orientation towards teaches (Spreitzer, 1995) our research offers an additional facet to better understanding learning outcomes.

THEORETICAL FOUNDATION

Defining Design Thinking for Entrepreneurship Education

Even though a common definition of design thinking is yet to emerge (Micheli et al., 2019), the various descriptions of design thinking share five common practices: user focus, problem framing, iteration, visualization and diversity (Von Kortzfleisch et al., 2013; Liedtka, 2015; Micheli et al., 2019). User focus emphasizes the importance of gaining an in-depth understanding of users and their needs. It is achieved through building empathy for the end users, as well as actively involving users in the problem solving process (Liedtka, 2015; Kolko, 2015). Problem framing refers to widening the initial problem space through questioning initial assumptions (Brown & Wyatt, 2010; Lindberg et al., 2010). Iteration refers to the trial-and-error approach design thinking relies on when developing ideas (Hassi & Laakso, 2011; Von Kortzfleisch et al., 2013). The iterative nature is intertwined with extensive use of visualization – quick-and-dirty prototypes of ideas that help to forward the discussion about ideas in the team and with end users (Carlgren et al., 2016). Finally, work in design thinking is organized in diverse teams, composed of people with different skills, personalities, and functional and social backgrounds, which allows incorporating diverse perspectives throughout the process (Pape et al., 2008; Lockwood, 2009; Hassi & Laakso, 2011; Von Kortzfleischt et al., 2013).

Since design thinking is a rather new method for entrepreneurship education, there is no official guideline for how to best incorporate it into the curriculum (Von Kortzfleisch et al., 2013). However, despite the differences in course length and formats, all of the known design thinking courses in entrepreneurship education programs rely on projects also known as design challenges that students have to solve. These projects are largely based on five iterative steps, i.e. empathize, define, ideate, prototype and test - that student teams navigate through while working on a design challenge (Kremel & Edman, 2019; Lynch et al., 2021; Ohly et al., 2017; Von Kortzfleisch et al., 2013).. This process incorporates all five design thinking practices; even though each of the iterative steps can be supported by numerous tools and methods (Brown, 2008; Lynch et al., 2021) and can exercise the practices to a different extent. For example, one design thinking project in an entrepreneurship course might only incorporate user-focus through interviews with customers, while another might also directly involve customers in the idea generation and testing. Thus, design thinking projects in entrepreneurship education courses can vary in their application level of five design thinking practices, which has to be taken into account when investigating the effectiveness of design thinking in entrepreneurship education.

Hypothesis Development

Previous research has already indicated that participation in entrepreneurship programs incorporating design thinking practices might empower students to perform better and take responsibility for their learning success (Dym et al., 2005; Vanada, 2014). Therefore, we specifically focus on psychological empowerment as a mechanism behind the relationship between the application level of design thinking practices in the classroom and learning in terms of acquisition of know-how and new skills that can be used in other entrepreneurship projects.

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Psychological empowerment introduced by Conger & Kanungo (1988) and Thomas & Velthouse (1990) is defined as intrinsic task motivation reflecting an individual's orientation to his or her work role. It is a set of four cognitions, i.e., meaning, competence, self-determination and impact, which is shaped by work environment and is specific to the work domain (Thomas & Velthouse, 1990). The classroom is students' work environment, completing a design thinking project is students' task, and learning and developing their entrepreneurial competences are the behavioral outcomes they ultimately need to achieve (You, 2016). A more favorable perception of classroom environment and learning tasks is associated with active, persistent and change-oriented behaviors and, hence, a more active approach to learning (Spreitzer, 1995). Thus, we argue that increased meaning, competence, self-determination and impact that students acquire when applying design thinking practices are the core mechanisms through which design thinking realizes it's positive effects on students' perceived learning outcomes in entrepreneurship education.

The amount of energy students put into generating high quality work has been associated with perceived meaning of a task (Glasser, 1990). This means that the more students recognize meaning (i.e., the value of learning) (Thomas & Velthouse, 1990), the more effort they put into their course. Design thinking, specifically its user focus, helps students to recognize the meaning in learning. User focus in design thinking requires building empathy through observing and interacting with customers. This exposure to customers through ethnographic techniques makes students understand user behavior and needs (Dunne & Martin, 2006; Nielsen & Stovang, 2015), helps them to identify entrepreneurial opportunities and to see more clearly the benefit that developing an appropriate solution would offer to customers. This, in turn, can help students recognize the value of mastering design thinking practices for their future entrepreneurial activities and put more effort into learning design thinking tools and methods. In turn, the more effort students put into learning and mastering these tools and methods, the better their perceived learning outcomes are going to be.

One of the most important antecedents for self-directed learning and academic performance is an increased confidence in one's abilities to perform certain tasks with skill (Bandura, 1986). Through direct experience of mastery and vicarious experiences, design thinking helps students to increase this confidence also known as competence or self-efficacy (Gist, 1987). Design thinking projects or design challenges in entrepreneurship education programs encourage students to try out new practices from a variety of complementary disciplines. Practices from innovation and creativity are useful when integrating the user as co-developer and generating a broad range of new ideas. Creating simple visual representation of the concepts, such as low-fidelity prototypes, involves practices from engineering, IT and design. Trying out this variety of tools and methods corresponds to direct experience of mastery, which is an essential source of building self-efficacy (Bandura, 1986). Furthermore, as design thinking projects are usually a team activity; the setting allows students to see other team members learning these new practices. This vicarious experience further builds confidence in one's own abilities to perform these tasks (Bandura, 1986). Highly self-efficacious students are more likely to associate learning with the potential to enhance their performance. Hence, they invest more effort in design projects that can help them improve their performance level (Henao-Zapata & Peiro, 2018) and should have higher perceived learning outcomes.

Motivation to learn, which is necessary to achieve positive learning outcomes, is positively associated with self-determination and impact which students experience from their work in the classroom (Frymier et al., 1996). Design thinking promotes self-determination in

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several ways. Teams in design thinking are self-directed, making decisions about the next steps autonomously (Lockwood, 2009). Due to the iterative nature of design thinking, participants autonomously decide how to move between different spaces of innovation, i.e., inspiration, ideation and implementation (Pape et al., 2008). This iterative nature of design thinking and increased project ownership can lead to stronger belief in having a choice in initiating and regulating activities (Deci et al., 1989). Furthermore, design thinking also promotes the perceived impact. The more students engage in previously described design thinking practices like gaining empathy for the user, involving the user in co-development of ideas, building low-fidelity prototypes and gathering user feedback, the more they should feel that their effort makes a difference in class. Through constant involvement in these activities, they might feel that the effort they put into learning these practices results in an improvement in their own skills and hence makes a difference in learning. In turn, higher self-determination and impact can have a positive impact on learning outcomes as it fosters students' motivation and they will invest more time in learning. Following these arguments, we suggest:

> ***H1:*** *Higher application level of design thinking practices has a positive relationship with learning outcomes, mediated through psychological empowerment.*

Nevertheless, we cannot exclude the possibility of a direct positive relationship between design thinking and learning outcomes as a proxy for alternative mechanisms explaining the relation between design thinking and learning outcomes. There are three alternative mechanisms that could explain such a relationship. First, positive learning outcomes that design thinking creates could be affiliated to action (Marquardt, 2018) and experiential learning principles (Kolb, 1984) which courses based on design thinking incorporate. Action and experiential learning principles such as a significant and urgent problem to work on, experimentation, reflection, feedback, autonomy and active participation are all common aspects inherent in design thinking projects that students have to carry out in the majority design thinking courses in entrepreneurship education. Design thinking projects are typically based around significant and urgent problems also referred to as wicked problems (Rittel & Webber, 1973). Design thinking courses are iterative in nature, fostering students to reflect on their progress, learn from it and make feedback loops (Nielsen & Stovang, 2015). Furthermore, design thinking requires active involvement and autonomous decision making from all participants (Lockwood, 2009). These principles have been proven effective in fostering positive learning outcomes in terms of different managerial skills (Gosen & Washbush, 2004; Leonard & Marquardt, 2010). They have also been recognized especially valuable for entrepreneurship education courses as they are expected to prepare students for the complex real world and could therefore create a sense of more learning (Neck & Greene, 2011; Rasmussen & Sorheim, 2006).

Second, the positive learning outcomes in courses based on design thinking can be associated with different thinking styles facilitated by this approach: Design thinking is based on inductive, deductive and abductive reasoning (Dunne & Martin, 2006). Idea generation requires abduction, narrowing down and developing the best ideas needs deduction, followed by induction to test and generalize the results. Whereas induction and deduction are critical components of the current education system, abductive reasoning – the process of searching for what could or might be right – stops being facilitated very early (Dunne & Martin, 2006; Martin & Euchner, 2012). Most business schools emphasize analytical deductive thinking that students can apply to a set of options that are based on past experiences. This type of thinking is prevalent in the areas of finance, business analytics and accounting, all of which constitute a large part of entrepreneurship education programs. Hence, even though thinking like designers, searching for

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completely new ideas and forming hypotheses of what might be are increasingly integrated in the curricula of entrepreneurship courses, students might perceive their learning in a design thinking course more beneficial as it requires more types of thinking.

Third, another alternative mechanism might relate to the change of mindsets. Various design thinking practices stimulate a change in mindset and make the individual more inclined to be curious, open and biased towards action (Carlgren et al., 2016). Such a mindset can in turn have a positive effect on the learning outcomes. For example, previous research has shown that curiosity is a strong motivator of effective learning experiences as curiosity positively influences the individual ability to memorize information (Gruber et al., 2015).

Following these arguments, it is possible that alternative mechanisms explain the relationship between design thinking practices and learning outcomes. Therefore, the mediation hypothesis presented before (H_1) is complemented by the following control hypothesis capturing these alternative explanations:

> ***H_2*:** *Higher application level of design thinking practices has a positive relationship with learning outcomes.*

METHOD

Data Collection and Sample

We tested the proposed hypotheses with empirical data collected from 160 university students of business engineering who participated in a course during which they had to complete a company project. In each of the 62 projects the participants had to develop a new product or service for a company. Exemplary project goals were developing a new industrial door or searching for new solutions to address mobility issues in rural areas. The projects were conducted under supervision of a professor or a senior lecturer. The application level of design thinking practices differed in all projects.

After project completion, participants filled out an online survey including the constructs of interest in this study. Due to the focus on individual-level outcomes, i.e., psychological empowerment and learning, the individual informant was selected as the appropriate unit of analysis. To test for potential common method bias, Harman’s single factor test was performed (Podsakoff & Organ, 1986), which does not indicate such a bias: The results of explorative factor analysis show 10 factors with eigenvalues greater than one and none of them accounted for the majority of the variance.

Measurement Scales

Drawing on prior literature, established reflective multi-item scales were used wherever possible. Respondents could answer on a five-point Likert type scale (1=“*does not apply at all*” to 5=“*fully applies*”). All items and their sources are reported in Appendix 1 and 2.

Learning was measured with four items from Denison et al. (1996) that captured how informants assess the contribution of the project to their knowledge and skills. Psychological empowerment was assessed with six items from Spreitzer (1995) that asked whether the informants perceived the work on the project meaningful, impactful, as providing the desired level of task autonomy, and as indicating their ability to perform. The Application level of design thinking practices was assessed using the multi-dimensional operationalization from Roth et al. (2020) which decomposes design thinking into five dimensions: user as an information source,

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problem framing, and user as co-creator, prototyping, and iteration. Each dimension was captured with four reflective indicators from prior literature, whereas the dimensions are formative indicators of the higher-order composite index design thinking, a scale conceptualization also referred to as Type II second-order factor model (Jarvis et al., 2003).

Several covariates were added to control for further factors that might affect learning. Creative self-efficacy was captured with three items from Tierney & Farmer (2002) because individual beliefs in one's own abilities to perform in innovation tasks might affect the perceived learning experience. The team diversity might also influence the building of skills and knowledge and thereby learning. It was assessed with three items from Van der Vegt & Janssen (2003) which measured whether team members differed in their beliefs, views, and their thinking. Finally, the perceived project performance might have an effect on perceived learning, thus, six items from Hoegl & Gemünden (2001) were used to assess whether technical, process, and quality-related objectives of the project were met (Hoegl et al., 2004).

Scale Properties

To assess the reflective measurement scales, including the sub-dimensions of application level of design thinking practices, we first investigated internal consistency reliability. Principal component analysis (varimax rotation) was performed separately for the indicators of each construct. Only a single factor with eigenvalue greater than one was extracted for each scale, which indicates the uni-dimensionality (Ahire & Devaraj, 2001). The Cronbach's alpha scores between 73 and 0.88 also ranged within acceptable levels (Hair et al., 2006).

Application level of design thinking practices captures how comprehensive this approach was applied at the project level. Therefore, the individual ratings of the team members within a project had to be aggregated by calculating the mean over individual responses to provide a reliable measure of this essential project characteristic. The scale construction followed recommendations of Chan (1998) on how to implement a referent-shift consensus composition by referring the questions to the project. Next, the intra class correlation coefficient (ICC 1, k) that informs about the inter-rater reliability and agreement (Shrout & Fleiss, 1979) was calculated to validate the assumption that this constructs varies at the project level. This is supported by an ICC (1, k) of 0.68 for application level of design thinking practices. With 68% of the variance of the score located at the project level, the agreement among project members is strong and supports the appropriateness of the applied referent-shift consensus composition. As expected, the ICC (1, k) of the remaining individual-level characteristics is low (0.02 to 0.33), which supports to draw on the individual-level data for the main model evaluation to test the effects on psychological empowerment and learning.

To further test the measurement model (and subsequently also the main model), we created a partial-least squares structural equation model (Software Package SmartPLS 3). We preferred structural equation modeling to traditional stepwise regression because it is recommended particularly when assessing mediation models by estimating all relationships simultaneously (Iacobucci et al., 2007). We furthermore chose partial least square (PLS) over covariance-based structural equation modeling (CBSEM) because integrating constructs with composite indicators (like the operationalization of application level of design thinking practices) in CBSEM causes parameter identification problems with paths to and from the composite construct, and the additional specifications necessary to resolve those issues make the interpretation of the estimated effects difficult (Sarstedt et al., 2016).

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The PLS-model specified the relationships between the constructs as proposed in the hypotheses. We implemented the Type-II measurement model of application level of design thinking practices by applying the repeated indicator approach (Wold, 1982) because each lower-order dimension is defined by the same number of indicators, which avoids that the estimated relationships between higher and lower-order dimensions are biased (Becker et al., 2012). Estimated paths, weights, and loadings were estimated and their significance was tested using bootstrapping (5,000 subsamples) (Efron & Tibshirani, 1993).

Results of the measurement model show indicator reliability for all reflective constructs with significant factor loadings which are almost all of them above 70 (Fornell & Cha, 1994) and clearly above the threshold of 0.40 (Hulland, 1999). Convergent validity is demonstrated with average variance extracted values clearly above 0.50 (Chin, 1998). All items correlate higher with their associated construct than with any other construct, demonstrating discriminant validity at the indicator level. At the construct level, discriminant validity is supported by the square root of the average variance extracted of each construct being greater than the highest correlation with any other construct (Fornell & Larcker, 1981).

Regarding the composite specification of application level of design thinking practices at the higher order, multi-collinearity among the five dimensions were assessed first but with the highest variance inflation factor being 2.51 do not indicate any issues. Furthermore, factor weights of all dimensions are significant, which supports that all dimensions contribute to the higher-order index (Diamantopoulos & Winklhofer, 2001). The dimensions only slightly differ in their contribution to the higher-order application level of design thinking practices index (weights range between 0.22 and 0.29), which provides empirical support for the idea that all five dimensions are relevant and defining elements. Mean, standard deviation, and correlations of the constructs are summarized in Table 1 and the results of the measurement model are presented in Appendix 1, 2 and 3.

Table 1
MEAN, STANDARD DEVIATIONS, AND CORRELATION MATRIX[a]

Construct		Mean	S.D.	α	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	AVE
1.	Design thinking practices	4.71	0.89	(-)[b]	*(-)*											(-)
2.	User as information source	3.97	0.77	0.84	0.56***	*(0.82)*										.67
3.	User as co-developer	2.96	0.94	0.87	0.72***	0.53***	*(.84)*									.71
4.	Problem framing	3.57	0.77	0.82	0.72***	0.40***	.32***	*(.81)*								.65
5.	Prototyping	3.68	0.97	0.91	0.72***	0.17*	.29***	.45***	*(.88)*							.78
6.	Iteration	2.96	0.90	0.86	0.77***	0.17*	.46***	.51***	.57***	*(.84)*						.71
7.	Psychological empowerment	3.74	0.63	0.85	0.43***	.28***	.31***	.42***	.21***	.35***	*(.76)*					.58
8.	Creative self-efficacy	3.83	0.57	0.58	0.30***	.33***	.26***	.29***	.16	.06	.24**	*(.73)*				.54
9.	Team diversity	3.47	.81	.80	.03	-.01	.02	.18*	.00	.02	-.05	.12	*(.77)*			.60
10.	Project performance	3.98	0.81	0.88	0.40***	0.40***	0.23**	0.34***	0.20*	0.20*	0.44***	.29***	-0.12	*(.79)*		0.63
11.	Learning	4.07	0.76	0.88	0.41***	0.17*	.29***	0.29***	0.26**	.39***	0.55***	0.20*	-	0.50***	*(.76)*	0.74

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													0.10			

[a] S.D.: standard deviation: α: Cronbach's alpha; AVE: Average Variance Extracted; Square root of AVE reported along the diagonal.
[b] Formative weighted index of its five underlying dimensions
* p<0.05; ** p<0.01; *** p<0.001. (two-tailed).

RESULTS

The size, sign, and significance of the path coefficients inform about the strength of the relationship. R^2 indicates the percentage of variance explained in the dependent variable (Chin, 1998). Considering the model complexity and sample size, we also report the adjusted R^2 values. The effect size f^2 informs whether the effects are weak ($f^2>0.02$), moderate ($f^2 >0.15$), or strong ($f^2>0.35$) (Cohen, 1988). The results are summarized in Table 2 and are depicted in Figure 1.

Table 2
PLS MODEL RESULTS[a]

Hypothesis	Independent		Dependent	β	t	p	Adj. R^2	f^2	Indirect effect
H_1	Design thinking practices	→	Psychological empowerment	0.39***	5.34	0	0.15	0.18	(-)
H_2	Psychological empowerment	→	Learning	0.36***	4.86	0	0.4	0.15	(-)
H_3	Design thinking orientation	→		0.08	1	0.319		0.01	0.14***
Control	Creative self-efficacy	→		0.01	0.08	0.936		0	(-)
Control	Project Performance	→		0.33***	3.85	0		0.13	(-)
Control	Team diversity	→		-0.09	0.92	0.319		0.01	(-)

a β, path coefficient; t, t-value; Adj. R^2, adjusted explained variance; f^2, effect size
† p<0.10; * p<0.05; ** p<0.01; *** p <0.001 (two-tailed).

The results support that application level of design thinking practices has a positive relationship with Psychological empowerment (β=0.39; p<0.001), explaining 15% of its variance. The effect sizes can be considered moderate to strong ($f^2=0.18$). The data also support that Learning is positively associated with higher Psychological empowerment (β=0.36; p<0.001; $f^2=0.15$). Together with the control variable Project performance with its positive relationship (β=0.33; p<0.001; $f^2=0.13$), 40% of the variance in Learning is explained by the model. The other control variables have no relationship with the dependent variable. The direct relationship between application level of design thinking practices and Learning is not significant (β=0.08; p=0.32; $f^2=0.01$), suggesting that the effect of the application level of design thinking on Learning is fully mediated through Psychological empowerment. The indirect effect of application level of design thinking through the mediating variable on Learning is .14 (p<0.001). To further assess the identified mediation effect, results of performed Sobel's z-test shows that the mediation effect is significant (z-value=3.60; p<0.001). Therefore, the results support Hypothesis 1 but reject Hypothesis 2.

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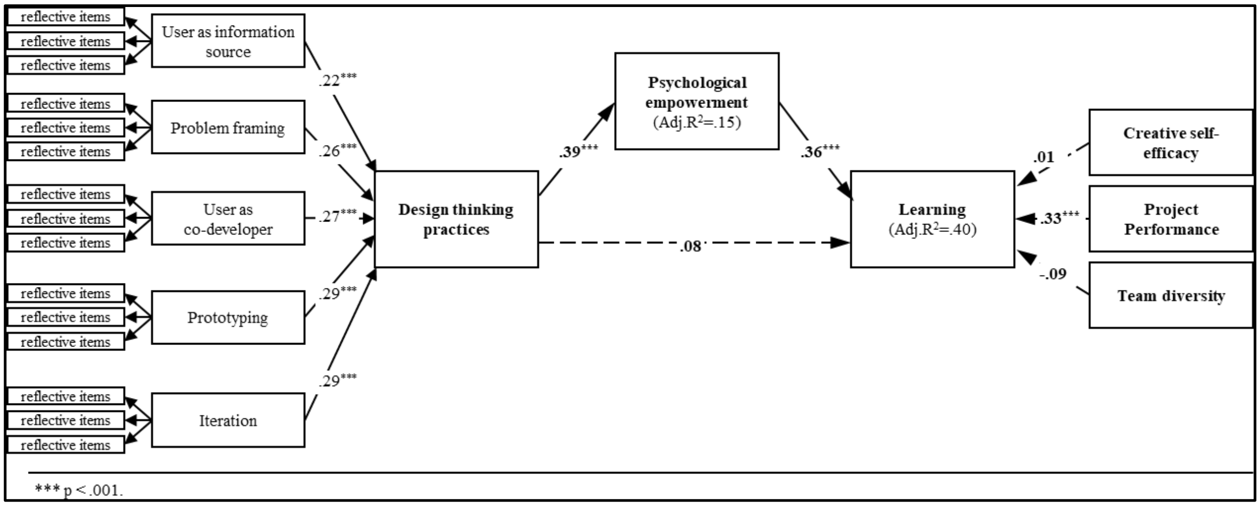

FIGURE 1
MODEL AND SIGNIFICANT PATH COEFFICIENTS

Since PLS is sometimes criticized to overestimate path coefficients and to lack global fit indices, we validated our results by applying the traditional OLS regression approach for mediation models (Baron & Kenny, 1986). The results are reported in Appendix 3 and support the robustness by replicating the PLS results.

DISCUSSION & CONCLUSION

Contribution & Implications

The present study was designed to determine whether design thinking leads to higher learning outcomes and the underlying mechanisms of this relationship are. Drawing on the data from 160 students and their experience in real-life companies' projects that vary in their application level of design thinking practices, we find empirical support for the hypothesis that design thinking positively has a positive relationship with learning outcomes through psychological empowerment.

Our findings offer several contributions to the growing entrepreneurship education literature on design thinking as pedagogy in entrepreneurship education. Existing entrepreneurship education literature has highlighted the need to examine the effects of different pedagogical methods, especially competence model-related pedagogical methods (Nabi et al., 2017). Design thinking is a competence model-related pedagogy since teaching through design thinking practices allows educators to influence how students organize their intellectual resources into competences that help them actively solve real-life problems. With this study that takes a quantitative approach going beyond case studies dominating prior research, we strengthen the validity of arguments suggesting that design thinking results in superior learning outcomes. The methods used to capture the application level of design thinking practices can also serve as a base for future studies on design thinking effects in entrepreneurship education. Furthermore, as entrepreneurial emotions, feelings and affect play an important role in entrepreneurial thinking, past research has called for empirical studies that examine impact indicators related to emotions and mindset (Nabi et al., 2017). The mediating effect of the psychological empowerment that we have identified therefore enhances our understanding of its

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role in entrepreneurship education. Our findings show that psychological empowerment is not only a by- product of entrepreneurship education programs based on design thinking practices, but is also an important impact indicator and a predictor of impact measures associated with perceived gain of skills and knowledge.

This study also provides implications for entrepreneurship educators in higher education, who should pay a particular attention to teaching and learning resources and chosen pedagogies for the best higher education quality (Allam, 2018; Allam, 2020). First, our results suggest that it is a combination of several design thinking practices that creates positive learning outcomes. It might not be enough to solely incorporate low-fidelity prototypes or a singular interaction with a potential customer into an entrepreneurship course. In order to have the best learning outcome, educators should strive to incorporate all five facets of design thinking: user as an information source, user as a co-developer, iteration, prototyping and problem framing. Second, previous research has suggested that entrepreneurship programs have to include elements that facilitate empowerment in order to successfully encourage active approach to entrepreneurship (Henao-Zapata & Peiro, 2018). Our research suggests that incorporating design thinking practices is one potential way to facilitate mentioned empowerment. Due to increased self-confidence, self-regulation, flexible thinking and active engagement that psychological empowerment results into (Diener & Biswas-Diener, 2005), students will have more active orientation towards work and build positive entrepreneurial experiences that can encourage them to pursue entrepreneurial pass after their studies.

LIMITATIONS & FURTHER RESEARCH

The methodology applied in this study has certain limitations, which provide opportunities for further research. First, we investigated the effects of design thinking practices on students' perceived learning outcomes, which is a short-term, subjective impact measure. Future research could focus on long-term impacts of entrepreneurship education programs based on design thinking practices, such as number and type of start-ups established. Furthermore, future research could investigate whether design thinking practices result in enhancement of specific skills, such as entrepreneurial problem-solving skills, creativity and empathy. Therefore, multi-respondent study designs including supervisors' or peer evaluations would be valuable in future investigations to assess specific learning outcomes of students more objectively.

Second, we carried out our study in a homogenous environment among students with similar backgrounds, yet we did not control for such contextual factors as the behavior of educators. Prior research suggests interaction patterns between students and faculty such as supportive facilitation or coaching behaviors like active listening and active questioning might increase the learning effects (O'Neil & Hopkins, 2002). Therefore, future research might analyze the role that interaction patterns between educators and students play in realizing the effects of design thinking practices and further investigate proper coaching approaches to enhance the effects we observed.

CONCLUSION

In conclusion, this research provides evidence that the widely applied design thinking approach in entrepreneurship programs is indeed positively linked to learning outcomes previously mentioned in conceptual research and qualitative case studies. Therefore, introducing

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design thinking practices into entrepreneurship courses is an effective way to build competences students require for their entrepreneurial journey.

ACKNOWLEDGMENT

The research leading to these results has received funding from the FFG Dissertationsprogramm der Fachhochschule OÖ project no. 868831: Design Thinking – Its Effects on Product Innovativeness, Individual Development and Cognitive Biases.

APPENDICES

Appendix 1
MEASURES, LOADINGS, AND WEIGHTS FOR DESIGN THINKING PRACTICES[a]

Construct/Dimension/Source/Items	First order	Second order	
Design Thinking Practices	Factor loading	Factor weight	VIF
Dimension: User as information source Source: Cui & Wu (2017)		0.22***	2.18
We involved users as a key information source.	0.81***		
We actively transferred information gathered from users to the development team.	0.87***		
The transfer of information about users' needs and preferences took place frequently.	0.79***		
We used information about users' needs in the development of the new product or service.	0.81***		
Dimension: Problem framing Source: Based on Basadur et al. (2000)		0.26***	1.84
We searched out many different points of view before attempting to define a problem.	0.78***		
We clarified problems by breaking them down into smaller, more specific sub-problems.	0.83***		
We clarified problems by opening them up into broader, less limiting challenges.	0.83***		
We selected novel problem definitions.	0.8***		
Dimension: User as co-developer Source: Cui & Wu (2017)		0.27 ***	2.15
Users were actively involved in a variety of product or service designs and development activities.	0.86***		
Users frequently interacted with the development team during the development process.	0.87***		
Users provided frequent feedbacks and inputs on product or service designs.	0.88***		
The involvement of users constituted a significant portion of the overall product or service development effort.	0.77***		
Dimension: Prototyping Source: Based on Brown (2008)		0.29 ***	2.26
After idea generation we created visual or physical representations of our ideas to communicate them to the team.	0.87***		
After idea generation we created visual or physical representations of our ideas to gather feedback on our ideas.	0.92***		
Building visual or physical representations of our ideas constituted a significant portion of the overall development effort.	0.9***		
We created prototypes throughout the design process.	0.84***		

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Dimension: Iteration Source: Cui & Wu (2017)		0.29 ***	2.51
We took an experimental approach that relied on frequent trial and error to find the right product solution.	0.88***		
We viewed this project as cycles of experiments, learning and additional experiments.	0.9***		
We engaged in trial and error before we had a complete understanding of the market and technology.	0.74***		
We tested many different product solutions before we found the right one.	0.84***		
[a]VIF, Variance Inflation Factor. ICC; *** $p<0.001$ (two-tailed)			

Appendix 2
MEASURES AND FACTOR LOADINGS OF REFLECTIVE SCALES

Construct/Source	Scale/Items	Factor loading
Learning Source: Denison et al. (1996)	I was able to acquire important know-how through this project.	0.85***
	I learned important lessons from this project.	0.87***
	I have developed many new skills from working on this project.	0.87***
	I have learned things working on this project that I will use in other projects.	0.85***
Psychological empowerment Source: Spreitzer (1995)	My activities in the project were personally meaningful to me.	0.83***
	The work I did in the project was meaningful to me.	0.82***
	I became confident about my ability to do my job in the project.	0.83***
	I became self-assured about my capabilities to perform my work activities.	0.83***
	I had significant autonomy in determining how I do my job in the project.	0.62***
	I had significant influence over what happens in the project.	0.6***
Creative self-efficacy Source: Tierney & Farmer (2002)	I feel that I am good at generating novel ideas.	0.85***
	I have confidence in my ability to solve problems creatively.	0.66***
	I have a knack for further developing the ideas of others.	0.69***
Team diversity Source: Van der Vegt & Janssen (2003)	To what extent the members of the group differed in their way of thinking?	0.7***
	To what extent the members of the group differed in their knowledge and skills?	0.7***
	To what extent the members of the group differed in how they view the world?	0.9***
	To what extent the members of the group differed in their beliefs about what is right and wrong?	0.78***
Project performance Sources: Hoegl & Gemuenden (2004)	The project can be regarded as successful.	0.84***
	All team goals were achieved.	0.78***
	The team's output was of high quality.	0.81***
	The team was satisfied with its performance.	0.83***
	The project leadership was fully satisfied with the task progress of the team.	0.81***
	I see this project as a technical success.	0.68***

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** p<0.01 *** p<0.001 (two-tailed)

Appendix 3
OLS REGRESSION RESULTS

Dependent variable:	Psychological empowerment			Learning								
Variables	β	s.e.	p	β	s.e.	p	β	s.e.	p	β	s.e.	p
Intercept	(-)	0.07	0.999	(-)	0.07	0.998	(-)	0.07	0.998	(-)	0.06	0.998
Creative self-efficacy				0.06	0.07	0.358	0.04	0.07	0.554	0.01	0.07	0.934
Project performance				0.53***	0.07	0	0.48***	0.07	0	0.33***	0.08	0
Team diversity				-0.06	0.07	0.397	-0.08	0.07	0.255	-0.09	0.06	0.176
Design thinking practices	0.39***		0.07				0.15*	0.07	0.044	0.07	0.07	0.287
Psychological empowerment										0.36***	0.07	0
R^2	0.15			0.31			0.33			0.42		
Adj. R^2	0.15			0.3			0.32			0.4		
ΔR^2	0.15			0.31			0.02			0.09		
SEe	0.93			0.84			0.83			0.78		
F	28.87***			23.89***			19.31***			22.27***		
ΔF	28.87***			23.89***			4.12*			23.11***		

β: standardized beta coefficient; s.e.; standard error; p: level of significance; (Adj.)R2: (adjusted) explained variance. SEe: standard error of estimate
*p <0.05; **p<0.01; ***p<0.001; n=160

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Received: 17-Dec-2021, Manuscript No. AJEE-21-10526; **Editor assigned:** 22-Dec-2021, PreQC No. AJEE-21-10526(PQ); **Reviewed:** 31-Dec-2021, QC No. AJEE-21-10526; **Revised:** 12-Jan-2022, Manuscript No. AJEE-21-10526(R)**; Published:** 24-Jan-2022

Citation Information: Roth, K., Rau, C., Globocnik, D., & Neyer, A.K. (2022). Design thinking: A source of empowerment andlearning. *Journal of Entrepreneurship Educaton, 25*(S3), 1-17.