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## Self-regulated learning, team learning and project performance in entrepreneurship education: Learning in a lean startup environment



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### ABSTRACT

Contemporary entrepreneurship education (EE) is often based around a team-based challenge such as creating a new venture or solving a startup problem. A creative and professional solution to such a challenge requires individual and team efforts. At the level of the individual student, self-regulated learning (SRL) is proposed as an effective way to learn in entrepreneurial projects. At the level of a student team, team learning and psychological safety are hypothesized to contribute to group performance. Yet, there is little evidence to support these claims.

I seek to add to the literature by demonstrating the effects of SRL, team learning, and psychological safety on various assessment types in the context of an entrepreneurship class. Data is collected from 194 students in 41 groups. Analysis is performed with hierarchical linear modeling. The results suggest that SRL is positively related to assessments at the individual level. Team learning and psychological safety are positively related to assessments at the group level. The results inform educators, students, and entrepreneurs about effective learning strategies.

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### 1. Introduction

Entrepreneurship education (henceforth: EE) is an effective way to increase the supply of entrepreneurs in terms of quality and quantity (Martin et al., 2013). The popularity of EE is reflected in the large and growing number of institutes of higher education that provide EE (West et al., 2009), and in the large and growing interest in EE research (Grichnik and Harms, 2007). EE prepares students for a job market that is likely to be complex and uncertain and may contain spells of self-employment (Duval-Couetil, 2013). As research recognized the importance of technology-based entrepreneurship as the driver of dynamic capitalism (Kirchhoff, 1994) and force behind dynamic developments for example in nanotechnology (Walsh, 2003; Walsh, 2004) or pharmaceuticals (Tierney et al., 2013; Walsh et al., 2014), EE for technology entrepreneurship becomes even more relevant. Here the challenge is to prepare future leaders in entrepreneurship, innovation, and

management of technology with a set of knowledge, skills and attitudes that enable them to address global challenges (Groen and Walsh, 2013). While the literature has identified common bodies of knowledge for TE (Yanez et al., 2010), didactics for technology-based entrepreneurship are still debated.

This paper is positioned at this didactics debate in that it deals with performance effects of different learning methods for technology-based entrepreneurship classes (Byrne et al., 2014). It addresses the significant trend in EE from a classroom-centered education to experiential learning (Cooper et al., 2004; Pittaway and Cope, 2007) in which students are exposed to a large extent to a real-life entrepreneurship context. Many learning methods are group-based (Pittaway and Cope, 2007), which allows not only for team learning (henceforth: TL), but also reflects the realities of new venture teams (Wu et al., 2009). An example of group-based experiential EE is the Lean LaunchPad initiative that applies the principles of customer development (Blank and Dorf, 2012) and Lean Startup (Ries, 2011) to technology-based startup projects. Such a course design has been adopted by the US National Science

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Foundation (Blank and Engel, 2013), top global universities and in EE in higher education in general (Högsdal, 2013).

One can assume that group-based experiential learning is a core learning strategy not only for EE, but also reflects the way “real” entrepreneurs as well as innovation professionals (Lynn et al., 1996) develop their business. For example, on the practical level we see an increasing amount of startups that are created using the lean startup approach. On the theoretical side, we see that early customer integration in the entrepreneurial process can be an example of the “socio-cognitive dynamics of entrepreneurial ideation” (Gemmell et al., 2012 p. 1053). If this is so, the question of effective group-based experiential learning in EE extends beyond the classroom towards new ventures (Levie and Autio, 2008) and innovation management.

As group-based experiential learning is a predominant learning context in EE and new ventures, the question arises under what conditions learners learn most effectively. This paper addresses this question by inquiring into the degree to which individual learning or team learning impacts on the achievement of learning outcomes in the classroom setting. A gap in research on entrepreneurial learning as well as in research on self-regulated learning Table 1 is in bringing together the individual side of SRL and the social side of team learning in one analysis. The research question is about the relative importance of SRL and team learning in group-based EE. The results can assist students and entrepreneurs to find effective learning strategies, and teachers and coaches to design effective didactical approaches for their classes. The findings may be extended to encompass the application to early-stage entrepreneurs.

## 2. Theory

### 2.1. Group-based experiential learning in lean startup

Lean startup (henceforth: LS) is a collection of tools and techniques that can be employed by entrepreneurs to build their ventures faster and at lower cost. It is based on the idea that entrepreneurs should make their implicit assumptions about how their venture works and how the market works explicit. These explicit assumptions can be put to empirical tests in the “real world”. The goal of these tests is to de/validate these assumptions and to get a better understanding of how a new venture can “really” work. In what is called the build–measure–learn loop, which is modeled after the empirical cycle, entrepreneurs are performing research about the “success factors” of their venture by testing their assumptions. In doing

so, LS is a method for entrepreneurial learning, with learning defined as a “relatively permanent change in knowledge or skill produced by experience” (Weiss, 1990, p. 172). More precisely, it is an example of experiential learning in that entrepreneurs learn while experimenting in a real-life setting. In new venture teams, LS becomes an example of group-based experiential learning.

Innovation and technology management scholars may know the lean startup approach under the names of “disciplined entrepreneurship” (Sull, 2004), “lean startup” (Blank, 2013), “hypothesis-driven entrepreneurship” (Eisenmann et al., 2011), and “probe and learn” (Lynn et al., 1996). In essence, these approaches emphasize early customer contact, reflected experimentation, and speed of learning in a technological context. This extends the applicability of lean startup from new ventures to mature companies, for example to reduce fuzziness at the front end of innovations (Stevens, 2014).

LS is not only used as an approach that is applied by more and more entrepreneurs worldwide (Blank, 2013), but it also becomes a framework entrepreneurship education (Blank and Engel, 2013). Classes based on LS are structured around the “build–measure–learn” loop in that students have to assess the nature of a customer problem, build a demo, test customer responses to that demo, and modify the demo according to the results of the customer assessment. In a more extended class design, all or most aspects of a business model canvas (Osterwalder and Pigneur, 2010) or a lean canvas (Maurya, 2012) are analyzed empirically. LS as group-based experiential learning is a setting in which students gain knowledge and skills about entrepreneurship in a context that is modeled rather closely to what real entrepreneurs need to know and do.

Assessment practices in EE in general and LS classes in particular include combinations of (\*) summative assessment of a students' success at a certain point in time vs. formative assessment with real-time feedback (Duval-Couetil, 2013), (\*) indirect assessment of perceived mastery vs. direct assessment based on outcomes such as tests or portfolios (Duval-Couetil, 2013), at (\*) the individual level or at the group level. Both educators who want their students to learn as well as students who want to achieve high assessments may be interested in learning strategies that lead to high assessment performance in addition to personally meaningful learning. In this paper, learning strategies that may be associated with (\*) individual and direct assessment of knowledge about entrepreneurship (the typical exam) and with (\*) group-based formative assessment of mastery of skills (the typical group project with feedback) are assessed.

**Table 1**  
Measurement of sub-scales for self-regulated learning.

		Cronbach $\alpha$	Inter-scale correlations				
			1	2	3	4	5
1	Planning	.685					
2	Self-monitoring	.795	.282**				
3	Evaluation	.815	.371**	.582**			
4	Reflection	.781	.382**	.421**	.406**		
5	Effort	.827	.411**	.340**	.370**	.411**	
6	Self-efficacy	.726	.231**	.398**	.447**	.284**	.284**

\*\*  $p < .01$ .

## 2.2. Learning styles and assessment results in the context of a lean startup class

### 2.2.1. Self-regulated learning in entrepreneurship education

Self-regulated learning (Zimmerman, 1989) is a didactical concept that emphasizes that a learners' abilities for metacognition, strategic action, and motivation (Ormrod, 2009) are a key to effective learning. It argues that it is these characteristics rather than inborn traits that are relevant for effective learning. While there are numerous models of SRL (Zimmerman, 1989; Boekaerts, 1999; Pintrich, 2000), the authors tend to agree on the value of an active role of the learner in shaping the learning process.

A phase model of SRL illustrates its elements (Cheng, 2011): First, learners assess their strengths and weaknesses with regard to a specific learning task. Second, learners execute strategic planning and goal setting with regard to mostly self-chosen learning goals. Third, learners implement their learning strategy and continuously monitor its effectiveness. Finally, learners compare the actual final learning outcome with the intended learning outcome. Such a model reminds business scholars of a strategic management process (Kaplan and Norton, 1996), with its widely discussed performance effects based on, among others, the motivational effects of goal setting and relevant feedback.

SRL is an effective learning strategy in that learners learn based on their own pace (Butler, 2002), with self-responsibility, and feedback that results in higher motivation (Oldham and Hackman, 2010). SRL is effective in increasing academic performance (Cheng, 2011). SRL is also effective in work-related training (Sitzmann and Ely, 2011), creativity (Hirst et al., 2009), and is used by early-stage entrepreneurs (O'Shea and Buckley, 2010). When Cheng (Cheng, 2011, p. 2) states that "if learners do not have [SRL] abilities, they learn by depending on the guidance and monitoring of others and fail to achieve a high level of learning", it can be assumed that SRL is even more effective in situations where guidance and monitoring of others are difficult. These situations can arise when the learning goal is ambiguous, can change dynamically, and needs to be formulated internally. These conditions apply to the entrepreneurial context. This makes SRL an effective learning strategy in an entrepreneurial context. The effectiveness of SRL as a learning strategy holds for both individual performance and team performance as individuals contribute to team performance (Knott and Kayes, 2012).

**H1a.** Self-regulated learning is positively related to individual learning performance.

**H1b.** Self-regulated learning is positively related to team performance.

### 2.2.2. Team learning in entrepreneurship education

Team learning is a team based "ongoing process of reflection and action characterized by asking questions, seeking feedback, experimenting, reflecting on results, and discussing errors or unexpected outcomes of actions" (Edmondson, 1999, p. 353). Numerous learning events in academia, in entrepreneurship (new venture teams), and in organizations in general are team-based (Senge, 1990). Previous research highlighted a positive impact of team learning on individual learning (Slavin,

1996; Sweet and Michaelsen, 2007), on the effectiveness of new product development teams (Akçün et al., 2006), on new venture teams (Hill et al., 2014) and generally on organizational learning (Crossan et al., 1999). Hill et al. (Hill et al., 2014) point out that team learning can be more effective than individual learning by bringing together a diversity of knowledge, experiences, and perspectives.

Individual performance is positively affected by team learning. Motivational, social cohesive, and cognitive effects (Slavin, 1996) play a role here. Hirst et al. (Hirst et al., 2009) use trait activation theory to argue that a context of team learning can activate those learners with a high individual learning orientation to show even more individual learning behavior. If the learning output is more reproductive, this may lead to higher performance. If the learning output requires action, however, team learning may trigger "over-learning" and less actual performance (Hirst et al., 2009). As this research focuses on the classroom context and not on a real startup context that requires real execution, we expect a positive relation between team learning and individual performance.

Team performance is also positively affected by TL: First, TL can focus on a specific entrepreneurial problem at hand. This is an outside perspective on TL. Here, the TL definition suggests that the TL process draws heavily on the empirical cycle and on the lean startup process. Hence, if a team can execute TL functions well, it can learn fast and generate empirically based insights about the functioning of the venture/market system that they are creating. In the context of an experiential classroom, teams that execute TL processes well should come up with solutions that are both valued highly by teachers and external clients. Second, TL can focus on team processes. This is an inside perspective on TL. Kayes et al. (2005) argue that teams that explicitly and systematically address team work challenges through TL can improve team performance. This is relevant, as there are several social processes that may keep a team from being effective, such as overdependence on a leader, groupthink, diffusion of responsibility, loafing, and others, that need to be addressed if a team wants to perform well (Kayes et al., 2005). Hence, we expect a positive relation between team learning and group performance.

**H2a.** Team learning is positively related to individual learning performance.

**H2b.** Team learning is positively related to team performance.

### 2.2.3. Psychological safety in entrepreneurship education

According to Edmondson (1999, p. 354) psychological safety (henceforth: PS) can be defined as "a shared belief that the team is safe for interpersonal risk taking (...) (it is) a sense of confidence that the team will not embarrass, reject, or punish someone for speaking up." The literature frames PS as an aspect of social capital (Lee et al., 2011) and of organizational culture (Baer and Frese, 2003). PS helps team members to think and behave in creative ways, to engage in trial-and-error learning, and to voice issues about content and team processes. PS can set a positive affective tone that enables knowledge sharing (Tsai et al., 2014). Hence, a climate of PS contributes to successful team learning.

While cumulative evidence points to a positive impact of psychological safety on team performance, the exact nature of this relationship remains an issue of debate. Some see the PS–performance relationship as *being mediated* by knowledge sharing (Kessel et al., 2012), and team learning behavior (Edmondson, 1999; Hill et al., 2014), or both (Huang and Jiang, 2012). Others see PS as a *mediator* between knowledge sharing and performance (Lee et al., 2011) and as having a *direct relationship* to team performance (Lee et al., 2011). Yet others conceptualize PS as a *moderator* between innovativeness and performance (Baer and Frese, 2003). I argue that the type of relationship may depend on whether a team has a previous working history or not.

When a particular team already exists for a while, PS can be an aspect of organizational culture that exists prior to a particular team's interactions and learning. In such a context, PS can be mediated by team processes, as a mediation suggests a cause–effect relationship with the mediator following the mediated variable in a sequence of events (Baron and Kenny, 1986). In a context in which a team is not embedded organizationally or does not have a working history, such as in team startups or in this classroom context, PS does not exist prior to the existence of a particular team. Rather, there is a co-development of PS and team learning that together impact on team performance: PS is based on trust (Kessel et al., 2012) and high-quality relationships (Carmeli and Gittell, 2009) that in turn develop through continuous successful episodes (Fink and Harms, 2012) of team learning and team performance. This co-development suggests that successful teams have a high level of both PS and TL, and relatively unsuccessful teams may have a low degree of both. This suggests a moderated relationship in that PS impacts on the relationship of TL and performance (Hypothesis 3).

In particular, the context of a classroom that is following a course based on group-based experiential learning suggests that team members are confronted with ambiguous information, and need to behave in creative ways. In particular, the context of a lean-startup class is characterized by trial-and-error learning where team members have to interact to reach the learning goals and to deliver creative solutions to external clients. Hence, a joint impact of psychological safety and team learning on team performance can be expected in this research setting.

**H3.** The higher psychological safety, the stronger the relationship between team learning and team performance.

### 3. Method

#### 3.1. Research context and sample

The research context is a 3rd-year bachelor business administration course on Entrepreneurship at a Dutch university. The key activity of this project-based course was to execute a project following a lean startup-based course outline. The project assignments were given by entrepreneurs who were seeking assistance in customer problem validation, solution development, and solution validation (Maurya, 2012). While the content of the projects differ by group, the deliverables were clearly specified in a course guide. This creates a basis for comparability of the group performance.

The course had 194 participants that created 41 groups with an average of 5 persons per group. The sample size differs per analysis: in the analysis of individual test performance, data from 172 participants can be used as 22 decided not to fill out the questionnaire and I did not impute missing data on a dependent variable. In the analysis of external group assessment, data from 82 participants in 20 groups were used, as 5 groups did not have external clients, and for 16 groups, the external clients did not respond. In all other instances, Little's MCAR tests suggests that data are missing completely at random ( $\chi^2 = 962.38$  DF = 1101, sig. = .999). In fact, 99.23% of the values were complete. Those values that were missing were imputed with the MCMC method with one iteration.

Data on learning strategies were collected via a self-administered questionnaire with the option to remain anonymous. Data on individual exam scores were assessed by the course teachers. Data on perceived entrepreneurial skills were self-assessed from the students. Data on the first group-level dependent variable – group assessment teacher – was collected from the course teachers. Data on the second group-level dependent variable – group assessment entrepreneur – was collected from the entrepreneurs that gave the assignment. To avoid social desirability bias, the entrepreneurs were informed that their assessment would not impact on the students' course grade, and the data were collected via a survey. As dependent and independent variables were collected by different methods and at different times, there is little concern for common method bias in this study. The fact that data on the independent variables was collected earlier than data for the dependent variables provides a stronger basis to infer causality of the relationships that are analyzed.

#### 3.2. Operationalization

Control variables at the individual level are gender and the average grade of previous courses. Control variables at the group level are group size and team tenure (Post, 2012). Team tenure is the average time that group members have known each other. This may positively impact on learning and tacit coordination (Edmondson, 2002). The group-level variables are assessed individually and aggregated as the means of the individual responses.

The individual-level predictor is *self-regulated learning* which is based on the SRL-SRS from Toering et al. (Toering et al., 2012). Toering et al. (Toering et al., 2012) provide a scale for self-regulated learning based on Zimmermann (Zimmerman, 1989). They proposed a 6-factor solution that was validated in this study by an exploratory factor analysis with Kaiser-criterion and Varimax rotation (Table 1). Hence, SRL will be operationalized as a formative first-order, reflective second order construct (Jarvis et al., 2003).

The group-level predictor *team learning* is based on Edmondson's team learning behavior scale (Edmondson, 1999). It is a reflective construct with four items that have a Cronbach's  $\alpha$  of .787 (EFA with Kaiser criterion and Varimax rotation) (Table 2). The group-level predictor *psychological safety* was taken from Edmondson (Edmondson, 1999). In this analysis, the single-factor structure proposed by Edmondson (Edmondson, 1999) could not be reproduced empirically. As the items all reflect psychological safety on the conceptual level, a formative

**Table 2**  
Correlation table.

	Mean/stdv/C.α	1	2	3	4	5	6	7	8	9	10
1 Gender	57.4% male										
2 Avg. previous grade	7.02/46/-	.148*									
3 Team size (mean)	4.96/.82/-	-.051	.028								
4 Team tenure (mean)	23.85/9.72/-	.189*	.113	-.400**							
5 Self-regulated learning	136.10/13.55/-	.070	.323**	.067	-.001						
6 Team learning	5.29/.96/.787	.193**	.273**	-.009	.135	.619**					
7 Psychological safety	38.78/5.03/-	.155*	.111	-.039	.160*	.326**	.449**				
8 Individual exam points	21.16/5.42/-	.297**	.376**	-.261**	.198**	.240**	.229**	.109			
9 Individual entrepreneurial skills	19.49/4.76/.881	.122	.003	.078	-.155**	.236**	.303**	.234**	-.148*		
10 Group assessment teacher	7.17/.60/-	.174*	.351**	.026	.075	.265**	.344**	.398**	.218**	.283**	
11 Group assessment entrepreneur	62.72/21.52/.983	-.038	-.105	-.011	-.048	.075	.018	.313**	-.070	.321**	.304**

Correlation table; all variables on the first level; Pearson correlation. C α: Cronbach α, if applicable.

\*\* p < .01.

\* p < .05.

(unweighted additive) construct was calculated. For the analysis, grand-mean centered variables are used.

A first individual-level dependent variable *individual exam score* reflects the performance on the individual final exam where aspects of theory on lean startup, research methods used for lean startup, and execution of LS projects were assessed. Possible scores range from 0 to 40 points. It was given by the teachers. A second individual-level variable assessed the degree to which the respondents felt that they learned *individual entrepreneurial skills*. It is a self-constructed 4-item construct with a Cronbach alpha of .881. It was given by the students.

A first group-level dependent variable is the group grade which reflects the teacher's assessment of the group performance, the *group assessment teacher*. It is an unweighted average of the grades for five group deliverables that reflect the process of a lean startup project. Possible scores can range from 0 to 10 points. A second group-level dependent variable is composed of *team performance* from Edmondson (Edmondson, 1999) and *creativity of the solution* from Zhou and George (Zhou and George, 2001). Factor analysis suggests that the items pertaining to these two constructs form a single factor with a Cronbach α of .983. I call this construct *group assessment entrepreneur*. See table 2 for a the correlations between the variables (Table 2).

### 3.3. Method of analysis

As our model contains variables from the individual level and the group level, hierarchical linear modeling, HLM (Hox, 2002; Peugh and Enders, 2005) with RML-estimation (Corbeil

and Searle, 1976) was used. First, a null model was calculated. Then, a model with group-level effects only, and finally a model with group and individual-level effects were calculated. Starting with a solution that contained all variables, variables were deleted until variables significant at a level of under 5% remained. Usually this was the solution with the lowest BIC (Bayesian Information Criterion). In one case, BIC suggested the retention of a variable at 10% significance.

## 4. Results

### 4.1. Individual-level independent variable: individual exam score

A first analysis step shows whether there are group-level effects at all. The null model suggests that this might be the case as the intercept variance is on the border of being significant. Model 2 suggests that the group-level predictor team size is significantly related to the individual exam score. This can be seen in the significant coefficient, the fact that unexplained intercept variance is not statistically different from zero on model two, and a reduction in the BIC. A comparison of intercept variance between model 1 and model 2 reveals that 40% of the variance can be accounted for by team size. All other group-level predictors do not have a significant impact on intercept of the individual exam score. As the residual variance is still statistically significant from zero, individual-level predictors are included as a possible source for intercept variance (Table 3).

**Table 3**  
HLM with individual-level dependent variable "individual exam score".

	Model 1: null model	Model 2: level-2 predictors only	Model 3: level-1 and level-2 predictors
Intercept	21.12***	21.12***	13.08****
Team size		-1.69**	-1.84**
Gender			2.83****
Pregrade			4.45****
Self-regulated learning			.06*
Intercept variance	4.90*	2.95	5.38*
Residual variance	24.80***	24.94***	16.96****
BIC Deviance (-2LL)	1135.47	1126.56	1074.75
	1125.08	1116.18	1064.04

\*\*\*\* p < .0001.

\*\*\* p < .001.

\* p < .05.

The results from model 3 suggest that team size is negatively related to individual performance, women perform better, and a higher individual average of previous classes is associated with higher individual performance. Most importantly, SRL is associated with higher individual performance, lending support to hypothesis 1. A comparison of residual variance between model 2 and model 3 reveals that 31.9% of variance can be accounted for by the level-1 predictors.

#### 4.2. Individual-level independent variable: entrepreneurship learned

A first analysis step shows whether there are group level effects at all. The null model suggests that this might be the case as the intercept variance is significantly different from zero. Hence, group effects can be expected (model 2). The results suggest that *average team tenure* impacts negatively on *entrepreneurship learned*, and *team learning* impacts positively on this dependent variable. An attempt to include individual-level predictors reveals that none of these variables had a significant impact on *entrepreneurship learned* (Table 4). Hence, a model with level-1 and level-2 predictors is not reported.

#### 4.3. Group-level independent variable: group assessment teacher

The null model suggests significant group effects (Table 5). At the same time, individual effects can be ruled out as the ICC is 0.996, which suggests that 99.6% of the variance of the independent variable from its intercept can be explained by group-level effects (model 1). Model 2 shows that Team learning (at 10%), psychological safety, and their interaction are significant predictors for this group assessment. The relationship between team learning and performance is higher when psychological safety is high, respectively lower when psychological safety is low. Other team-level variables (team level controls) are insignificant. Also, individual-level variables remain insignificant, so a model 3 is not reported.

#### 4.4. Group-level independent variable: group assessment entrepreneur

The analysis on the group level assessment by the entrepreneur is based on 82 individual cases in 20 groups. Model 2 in Table 6 shows that team tenure, team size and team learning (negative at 10%), as well as psychological safety (positive) influence the group assessment by the entrepreneur. A null model could not be identified. An addition of level-1 predictors

**Table 4**  
HLM with Individual-level dependent variable “entrepreneurship learned”.

	Model 1: null model	Model 2: level-2 predictors only
Intercept	.003	.148
Average tenure		-.023*
Team learning		.463**
Intercept variance	.440****	.303**
Estimated residual variance	.590**	.587****
BIC	491.65	487.94
Deviance	481.25	477.56

\*\*\*\* p < .0001.

\*\* p < .01.

\* p < .05.

**Table 5**  
HLM with group-level dependent variable “group assessment teacher”.

	Model 1: null model	Model 2: level-2 predictors only
Intercept	-.016	-.039
Team learning		.296#
Psychological safety		.082**
Team learning * psycho. safety		.024*
Intercept variance	.383****	.237****
Estimated residual variance	.005****	.002****
BIC	-361.68	-368.61
Deviance	-372.08	-387.97

\*\*\*\* p < .0001.

\*\* p < .01.

\* p < .05.

# p < .1.

did not increase model quality, so a model 3 is not reported (see Table 6).

## 5. Discussion

The goal of this study was to analyze the impact of self-regulated learning, group learning, and psychological safety in the context of a lean-startup-based entrepreneurship class. We analyzed two individual level performance outcomes (exam scores and skill acquired), and two group level performance outcomes (group scores, and entrepreneur's assessment). The results of this analysis and their implications are discussed below.

Individual exam scores seem to be positively affected by self-regulated learning, but not team learning. This result suggests that meta-cognition, strategic action and motivation help students to achieve high individual scores. The missing link between group learning and individual scores must not suggest that group learning is ineffective. It can also suggest that students tend to learn individually for individual exams. More research will shed light on this aspect.

The perception of having learned entrepreneurship skills seems to be positively affected by group learning, but not self-regulated learning. It seems that group learning is highly important for skills learning. After all, it is in a team setting in which the skills were learned in an experiential way. It may suggest that there was little (need for) additional SRL on the skills component of this course.

Group performance seems to be positively affected by group learning, psychological safety, and their interaction. This result was expected by theory. What was somewhat surprising

**Table 6**  
HLM with group-level dependent variable “group assessment entrepreneur”.

	Model 2: level-2 predictors only
Intercept	-.078
Team tenure	-.054**
Team size	-.624**
Team learning	-.424#
Psychological safety	.313***
Intercept variance	Not computed
Estimated residual variance	Not computed
BIC	214.46
Deviance	210.09

\*\*\* p < .001.

\*\* p < .01.

# p < .1.

is that individual-level effects such as previous grades or self-regulated learning (which were unobserved in the final model) do not seem to play a significant role in explaining team performance. This suggests that the team size and team tenure as such do not seem to impact on group performance, as long as the team succeeds in creating team learning in a psychologically safe environment.

Implications for practice are numerous. Based on these results, it may be beneficial to teach students about SRL skills (Cleary and Zimmerman, 2004) and TL skills (Juvonen and Ovaska, 2012). In fact, some entrepreneurship programs are currently including content on SRL and TL skills in their business administration curricula. Teachers might consider monitoring and intervening when teams fail to create a psychologically safe atmosphere. Also, students can be trained on the positive impact a group leader can have on psychological safety (Edmondson and Nembhard, 2009). If it is so that psychological safety and team learning co-develop, it would imply that teachers could create early gains that help teams to gain confidence in their learning efforts. I would argue that these implications would be particularly effective in entrepreneurship classes when learning goals are often ambiguous and partially self-selected. Ambiguous goals and self-selected goals are also present outside the classroom, for example in R&D strategy development (Hooshangi et al., 2013), in virtual teams (Baruch and Lin, 2012), and in new venture teams. Hence, I suggest that the implications from this study also extend to the corporate world. However, trait activation theory suggests that in corporate contexts, practitioners need to find a balance between learning and action.

This paper has added to the literature on EE in that it shows that self-regulated learning has a positive impact on students' exam scores, but not on other individual and group-based aspects of an entrepreneurship classroom. This seems to indicate limits to the effectiveness of self-regulated learning in entrepreneurship. Another addition to the EE literature is that team learning, psychological safety, and their interaction positively affect group performance. This empirical finding can serve as a basis for a more thorough understanding of moderating and mediating relationships that affect EE in the classroom and ultimately in entrepreneurial ventures. For example, one avenue for further investigation may be an analysis of whether the role of psychological safety in team learning models depends on team tenure and organizational embeddedness of a team.

These implications and contributions to the literature have to be seen in the light of the limitations of this research. First, these results are based on data from one class in a Dutch university. While the results are in line with theory, I suggest that replication would be needed to assess the boundaries of generalization. Here it would be particularly interesting to systematically vary parameters such as the type of participants (bachelor, master, practitioners), the effect of prior education on the benefits of SRL, team learning, and psychological safety, and other didactical features (Carayannis et al., 2003; Al-Atabi and Deboer, 2014). Second, the relationships between the dependent and independent variables may be more complex than captured in this model. Such an added complexity is suggested by theory. Hence, future analyses could take this complexity into account, for example with multilevel path models (Hox, 2002).

Future research can go beyond these limitations and analyze the nature of the interactions between SRL, team learning and psychological safety in what could be a qualitative effort. Of particular interest could be the mechanism of building trust and psychological safety in a new learning group. In addition, other antecedents to effective learning in the context of experiential group projects would warrant attention. For example, Ellis et al. (Ellis et al., 2003) investigate the effect of team composition with regard to the big-5 personality traits and structural aspects such as workload distribution on team learning. Finally, research could be more explicit about the translation from an educational context to a startup context – would the same mechanisms be at play in real-life entrepreneurship, or could scarcity in time and money, and the higher stakes both in the risk of losing money and in the excitement of real entrepreneurship alter the team learning process? These are exciting questions that – if answered – will not assist only students but also entrepreneurs in learning effectively and to pursue their entrepreneurial journey with a little less uncertainty and a little more validated findings. The author is looking forward to more research on these issues.

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## References

- Akgün, A.E., Lynn, G.S., Yilmaz, C., 2006. Learning process in new product development teams and effects on product success: a socio-cognitive perspective. *Ind. Mark. Manag.* 35, 210–224.
- Al-Atabi, M., Deboer, J., 2014. Teaching entrepreneurship using Massive Open Online Course (MOOC). *Technovation* 34, 261–264.
- Baer, M., Frese, M., 2003. Innovation is not enough: climates for initiative and psychological safety, process innovations, and firm performance. *J. Organ. Behav.* 24, 45–68.
- Baron, R.M., Kenny, D.A., 1986. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J. Pers. Soc. Psychol.* 51, 1173–1182.
- Baruch, Y., Lin, C.-P., 2012. All for one, one for all: cooperation and virtual team performance. *Technol. Forecast. Soc. Chang.* 79, 1155–1168.
- Blank, S., 2013. Why the lean start-up changes everything. *Harv. Bus. Rev.* 91, 64–68.
- Blank, S., Dorf, B., 2012. *The Startup Owner's Manual*. K&S Ranch Press, Pescadero, CA.
- Blank, S., Engel, J., 2013. *The Lean LaunchPad Educators Teaching Handbook*.
- Boekaerts, M., 1999. Self-regulated learning: where we are today. *Int. J. Educ. Res.* 31, 445–457.
- Butler, D., 2002. Individualizing instruction in self-regulated learning. *Theory Pract.* 41, 81–92.
- Byrne, J., Fayolle, A., Toutain, O., 2014. Entrepreneurship education: what we know and what we need to know. In: Chell, E., Karatas-Özkan, M. (Eds.), *Handbook of Research in Small Business and Entrepreneurship & Regional Development*. Edward Elgar, Cheltenham, UK.
- Carayannis, E.G., Evans, D., Hanson, M., 2003. A cross-cultural learning strategy for entrepreneurship education: outline of key concepts and lessons learned from a comparative study of entrepreneurship students in France and the US. *Technovation* 23, 757–771.
- Carmeli, A., Gittell, J.H., 2009. High-quality relationships, psychological safety, and learning from failures in work organizations. *J. Organ. Behav.* 30, 709–729.
- Cheng, E.C.K., 2011. The role of self-regulated learning in enhancing learning performance. *Int. J. Res. Rev.* 6, 1–16.
- Cleary, T.J., Zimmerman, B.J., 2004. Self-regulation empowerment program: a school-based program to enhance self-regulated and self-motivated cycles of student learning. *Psychol. Sch.* 41, 537–550.

- Cooper, S., Bottomley, C., Gordon, J., 2004. Stepping out of the classroom and up the ladder of learning: an experiential learning approach to entrepreneurship education. *Ind. High. Educ.* 18, 11–22.
- Corbeil, R.R., Searle, S.R., 1976. Restricted maximum likelihood (REML) estimation of variance components in the mixed model. *Technometrics* 18, 31–38.
- Crossan, M.M., Lane, H.W., White, R.E., 1999. An organizational learning framework: from intuition to institution. *Acad. Manag. Rev.* 24, 522–537.
- Duval-Couetil, N., 2013. Assessing the impact of entrepreneurship education programs: challenges and approaches. *J. Small Bus. Manag.* 51, 394–409.
- Edmondson, A.C., 1999. Psychological safety and learning behavior in work teams. *Adm. Sci. Q.* 44, 350–383.
- Edmondson, A.C., 2002. The local and variegated nature of learning in organization: a group-level perspective. *Organ. Sci.* 13, 128–146.
- Edmondson, A.C., Nembhard, I.M., 2009. Product development and learning in project teams: the challenges are the benefits. *J. Prod. Innov. Manag.* 26, 123–138.
- Eisenmann, T., Ries, E., Dillard, S., 2011. Hypothesis-Driven Entrepreneurship: The Lean Startup, Harvard Business School Background Note 812–095.
- Ellis, A.P.J., Hollenbeck, J.R., Ligen, D.R., Porter, C.O.L.J., West, B.J., Moon, H., 2003. Team learning: collectively connecting the dots. *J. Appl. Psychol.* 88, 821–835.
- Fink, M., Harms, R., 2012. Contextualizing the relationship between self-commitment and performance: environmental and behavioral uncertainty in (cross-border) alliances of SMEs. *Entrep. Reg. Dev.* 24, 161–179.
- Gemmell, R.M., Boland, R.J., Kolb, D.A., 2012. The socio-cognitive dynamics of entrepreneurial ideation. *Entrep. Theory Pract.* 36, 1053–1073.
- Grichnik, D., Harms, R., 2007. Zur Zukunft der deutschsprachigen Entrepreneurshipforschung - Strategien und thematische Schwerpunkte. *ZfK 46*, 266–275.
- Groen, A.J., Walsh, S.T., 2013. World problems – emerging technologies: introduction to the field of creative enterprise. *Technol. Forecast. Soc. Chang.* 80, 187–190.
- Hill, A.D., Wallace, J.C., Ridge, J.W., Johnson, P.D., Paul, J.B., Suter, T.A., 2014. Innovation and effectiveness of co-founded ventures: a process model. *J. Bus. Psychol.* 29, 145–159.
- Hirst, G., van Knippenberg, D., Zhou, J., 2009. A cross-level perspective on employee creativity: goal orientation, team learning behavior, and individual creativity. *Acad. Manag. J.* 52, 280–293.
- Högsdal, N., 2013. Has the lean startup movement arrived at German universities – and should it? G-Forum, Koblenz.
- Hooshangi, S., Arasti, M.R., Hounshell, D.A., Sahebzamani, S., 2013. Evolutionary learning methodology: a case study of R&D strategy development. *Technol. Forecast. Soc. Chang.* 80, 956–976.
- Hox, J., 2002. Multilevel analysis. Techniques and Applications. Lawrence Erlbaum, Mahwah, New Jersey.
- Huang, C.-C., Jiang, P.-C., 2012. Exploring the psychological safety of R&D teams: an empirical analysis in Taiwan. *J. Manag. Organ.* 18, 175–192.
- Jarvis, C.B., MacKenzie, S.B., Podsakoff, P.M., 2003. A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *J. Consum. Res.* 30, 199–218.
- Juvenon, P., Ovaska, P., 2012. ICT entrepreneurship model: a new approach for information technology bachelor education. IFAC International Conference on International Stability and Systems Engineering, Waterford, Ireland.
- Kaplan, R.P., Norton, D.P., 1996. The Balanced Scorecard: Translating Strategy Into Action. Harvard Business School Press, Boston.
- Kayes, A.B., Kayes, C., Kolb, D.A., 2005. Experiential learning in teams. *Simul. Gaming* 36, 330–354.
- Kessel, M., Kratzer, J., Schultz, C.D., 2012. Psychological safety, knowledge sharing, and creative performance in healthcare teams. *Creat. Innov. Manag.* 21, 147–157.
- Kirchhoff, B.A., 1994. Entrepreneurship and Dynamic Capitalism. The Economics of Business Firm Formation and Growth, Praeger, Westport, Conn.
- Knott, M.J., Kayes, C., 2012. Individual contribution to a team: the importance of continuous adaptive learning. *Organ. Manag. J.* 9.
- Lee, J.Y., Swink, M., Pandepong, T., 2011. The roles of worker expertise, information sharing quality, and psychological safety in manufacturing process innovation: an intellectual capital perspective. *Prod. Oper. Manag.* 20, 556–570.
- Levie, J., Autio, E., 2008. A theoretical grounding and test of the GEM model. *Small Bus. Econ.* 31, 235–263.
- Lynn, G.S., Morone, J.G., Paulson, A.S., 1996. Marketing and discontinuous innovation: the probe and learn process. *Calif. Manag. Rev.* 38, 8–37.
- Martin, B.C., McNally, J.J., Kay, M.J., 2013. Examining the formation of human capital in entrepreneurship: a meta-analysis of entrepreneurship education outcomes. *J. Bus. Ventur.* 28, 211–224.
- Maurya, A., 2012. Running Lean. O'Reilly, Sebastopol.
- Oldham, G.R., Hackman, J.R., 2010. Not what it was and not what it will be: the future of job design research. *J. Organ. Behav.* 31, 463–479.
- Ormrod, J.E., 2009. Essentials of Educational Psychology. Pearson.
- O'Shea, D., Buckley, F., 2010. Modelling self-regulated learning strategies in early-stage entrepreneurs: the role of intentionality and interaction. *Int. J. Entrep. Small Bus.* 10, 83–107.
- Osterwalder, A., Pigneur, Y., 2010. Business Model Generation. John Wiley, Hoboken.
- Peugh, J.L., Enders, C.K., 2005. Using the SPSS mixed procedure to fit cross-sectional and longitudinal multilevel methods. *Educ. Psychol. Meas.* 65, 717–741.
- Pintrich, P.R., 2000. The role of goal orientation in self-regulated learning. In: Boekaerts, M., Pintrich, P.R. (Eds.), Handbook of Self-regulation. Academic Press, San Diego, pp. 451–502.
- Pittaway, L., Cope, J., 2007. Simulating entrepreneurial learning: integrating experiential and collaborative approaches to learning. *Manag. Learn.* 38, 211–233.
- Post, C., 2012. Deep-level team composition and innovation: the mediating roles of psychological safety and cooperative learning. *Group Organ. Manag.* 37.
- Ries, E., 2011. The Lean Startup. Crown Publishing, New York.
- Senge, M., 1990. The fifth discipline. The Art and Practice of the Learning Organization. Doubleday, N.Y.
- Sitzmann, T., Ely, K., 2011. A meta-analysis of self-regulated learning in work-related training and educational attainment: what we know and where we need to go. *Psychol. Bull.* 137, 421–442.
- Slavin, R.E., 1996. Research on cooperative learning and achievement: what we know, what we need to know. *Contemp. Educ. Psychol.* 21, 43–69.
- Stevens, E., 2014. Fuzzy front-end learning strategies: exploration of a high-tech company. *Technovation* 34, 431–440.
- Sull, D.N., 2004. Disciplined entrepreneurship. *MIT Sloan Manag. Rev.* 46, 71–77.
- Sweet, M., Michaelsen, L., 2007. How group dynamics research can inform the theory and practice of postsecondary small group learning. *Educ. Psychol. Rev.* 19, 31–47.
- Tierney, R., Hermina, W., Walsh, S.T., 2013. The pharmaceutical technology landscape: a new form of technology roadmapping. *Technol. Forecast. Soc. Chang.* 80, 194–211.
- Toering, T., Elferink-Gemser, M.T., Jonker, L., van Heuvelen, M.J.G., Visscher, C., 2012. Measuring self-regulation in a learning context: reliability and validity of the Self-Regulation of Learning Self-Report Scale (SRL-SRS). *Int. J. Sport Exerc. Psychol.* 10, 24–38.
- Tsai, Y.-H., Ma, H.-C., Lin, C.-P., Chiu, C.-K., Chen, S.-C., 2014. Group social capital in virtual teaming contexts: a moderating role of positive affective tone in knowledge sharing. *Technol. Forecast. Soc. Chang.* 86, 13–20.
- Walsh, S.T., 2003. Commercialization of microsystems. International Roadmap on MEMS, Microsystems, Micromachining and Top Down Nanotechnology. MANCEF, pp. 33–68.
- Walsh, S.T., 2004. Roadmapping a disruptive technology: a case study: the emerging microsystems and top-down nanosystems industry. *Technol. Forecast. Soc. Chang.* 71, 161–185.
- Walsh, S.T., Tierney, R., Giassoli, R., 2014. Pharmaceutical landscape; the initiation of third generation road-mapping for firms, industries and regions. MANCEF, p. 410.
- Weiss, H.M., 1990. Learning theory and industrial and organizational psychology. In: Dunnette, M., Hough, L.M. (Eds.), Handbook of Industrial and Organizational Psychology. Consulting Psychologists Press, Palo Alto, CA, pp. 171–221.
- West, G.P., Gatewood, E.J., Shaver, K.G., 2009. Legitimacy across the university: yet another entrepreneurial challenge. In: West, G.P., Gatewood, E.J., Shaver, K.G. (Eds.), Handbook of University-wide Entrepreneurship Education. Edward Elgar, Cheltenham, pp. 1–11.
- Wu, L.-Y., Wang, C.-J., Tseng, C.-Y., Wu, M.-C., 2009. Founding team and start-up competitive advantage. *Manag. Decis.* 47, 345–358.
- Yanez, M., Khalil, T.M., Walsh, S.T., 2010. IAMOT and education: defining a Technology and Innovation Management (TIM) Body-of-Knowledge (BoK) for graduate education (TIM BoK). *Technovation* 30, 389–400.
- Zhou, J., George, J.M., 2001. When job dissatisfaction leads to creativity: encouraging the expression of voice. *Acad. Manag. J.* 44, 682–696.
- Zimmerman, B.J., 1989. A social cognitive view of self-regulated academic learning. *J. Educ. Psychol.* 81, 329–339.

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