BRIA ROSE JAMMALI-VERSACE & BENITO CAMPOS

Teaching Entrepreneurship to Medical Students

A Proof-of-Concept-Study

ABSTRACT/ZUSAMMENFASSUNG

Startups haben einen starken, positiven Einfluss auf die nationale Wirtschaft und werden benötigt, um Innovationen in der Medizin und der Patient*innenversorgung voranzutreiben. Dies erklärt, warum Länder wie Deutschland Milliarden in die unternehmerische Ausbildung und Motivation investieren. Darüber hinaus konzentriert sich die derzeitige Politik zur Förderung des Unternehmertums auf innovative Startups, die aus akademischen Einrichtungen hervorgehen. Da Medizinstudent*innen an der Schnittstelle zwischen medizinischer Forschung und Patient*innenversorgung stehen, ist es wichtig, ihnen ein allgemeines Verständnis für die Bedeutung des Unternehmertums in der Medizin und in den Biowissenschaften zu vermitteln. Vor allem aber muss die unternehmerische Ausbildung Medizinstudent*innen motivieren und befähigen, medizinische Innovationen durch Unternehmensgründungen voranzutreiben, die wiederum dem allgemeinen Wohlstand und dem gesellschaftlichen Fortschritt zugutekommen. In einer Proof-of-Concept-Studie untersuchen die Autor*innen, ob Medizinstudent*innen Interesse an unternehmerischer Ausbildung zeigen, und ob ein eintägiges Blockseminar geeignet ist, um relevante Inhalte in einem interaktiven, praktischen Format zu vermitteln. Basierend auf den Ergebnissen und auf dem Feedback relevanter Akteur*innen des lokalen Startup-Ökosystems wird anschließend ein Konzept für ein zukünftiges Seminar zum Thema Unternehmertum für Medizinstudent*innen im Raum Heidelberg/Mannheim entwickelt. Die Autor*innen hoffen, dass die unternehmerische Ausbildung bald zu einem unverzichtbaren Bestandteil der medizinischen Ausbildung wird.

Schlagworte: Unternehmensgründung – Startup – Innovation – Entrepreneurship

Startups have a strong, positive effect on our economy and are needed to drive continuous innovation in medicine and patient care. Countries like Germany invest billions into entrepreneurial education. In addition, current entrepreneurship policies focus on innovative startups originating as spin-offs from within academic institutions. Since medical students are at the intersection of medical research and patient care, it is important to inculcate them with a general understanding of the importance of entrepreneurship in medicine and in the life sciences. Most importantly, entrepreneurial education must motivate and enable those physician-scientists that will drive medical innovation through the founding of medical businesses, ultimately benefiting society as a whole. In a proof-of-concept study, the authors investigate whether medical students show interest in entrepreneurial education and whether a one-day seminar is suitable to convey relevant content in an interactive, practical format. Based on their findings and based on feedback from relevant stakeholders from the local startup ecosystem, the authors develop the concept for a future seminar

on entrepreneurship for medical students in the Heidelberg/Mannheim area. It is the authors' hope that entrepreneurial education will soon become an indispensable part of the broader medical education curriculum.

Keywords: business formation – startup – innovation – entrepreneurship

Introduction

One of the most important aspects of German entrepreneurship policies is fostering innovative startups (FRITSCH 2019). Since the vast majority of founders of innovative companies attended a university, it is important to see universities as key environments for the promotion of entrepreneurship.

A model to emulate in terms of fostering and nurturing entrepreneurship is the Massachusetts Institute of Technology (MIT), which has long been a leader in the U.S. in terms of the number of startups founded by university alumni (ROBERTS, MURRAY & KIM 2019.). About 24 % of all former students and employees of that university started at least one business during their careers. Overall, companies founded by MIT graduates and employees have had a strong impact on the region's economic development. The MIT estimates that alumni have been among the founders of at least 30000 currently active companies and that these enterprises employ 4.6 million individuals and generate annual global revenues of $1.9 trillion. Such a positive effect of universities on regional development can also be seen for other universities (ÅSTEBRO, BAZZAZIAN & BRAGUINSKY 2012). Thus, national governments strongly endorse measures to foster an entrepreneurship culture, such as raising awareness among students at universities for the possibility of entrepreneurial independence, stimulating contacts with innovative founders, generating an entrepreneurship-friendly atmosphere at universities and teaching entrepreneurial skills.

Since the Rhein-Neckar region enjoys one of the highest concentrations of medical research institutions in Europe and is home to a vibrant startup ecosystem, students enrolled in local universities might show a particular interest in extracurricular teaching activities related to entrepreneurship. Heidelberg University's medical faculty has previously introduced a number of new elective courses, which now form part of the officially accredited "Wahlfachtrack", including courses related to digital medicine and global health. Such an elective track offers the opportunity to anchor entrepreneurship teaching into the medical curriculum.

Taken together, these general observations led the authors to 1) conduct a proof-of-concept study to test if medical students would show interest in a one-day entrepreneurship seminar and, should this be the case, 2) engage relevant stakeholders within the local startup ecosystem to design the outline for an entrepreneurship seminar that could be further refined in subsequent studies.

Preliminary work leading up to proof-of-concept study

Prior to this experiment one of the authors (B. C.) tested medical students' interest in entrepreneurship education in the context of a short online seminar. The outcome of this preliminary work was the basis for the authors' didactical experiment and is briefly summarized below.

The online seminar was conducted within the framework of the workshop "Qualifikation in der Lehre" (this workshop, led by the "QM-Team Medizin", was developed for teaching staff at the medical faculty of Heidelberg University and is aimed at increasing the quality of medical education). Two medical students participated and the seminar was evaluated by one member of the quality management team for medical education and by one senior faculty member at Heidelberg University Hospital. Both students had collaborated with one of the authors (B. C.) in a separate research project. They were recruited for this experiment because they had not been engaged in any entrepreneurial activity prior to the interview.

The pilot seminar was structured as a 30-minute online seminar. The teacher (B. C.) first revealed the goals of the pilot seminar, i. e. that the seminar would be evaluated by the quality management team for medical education and that student participants would be asked to give feedback on whether this trial seminar was interesting enough to be expanded further into a one-day seminar. The teacher went on to manage the audience's expectations in clear language ("What can you expect today? The seminar is structured in four parts. In the first part, I will explain why startups at universities are important […]"). The teacher then went on to name the learning outcomes in clear language ("What do I want you to take away from this seminar? In two sentences: If you want to start a business, I want you to be able to name what the necessary first steps are. If you don't want to start a company, you should be able to explain why it is important that companies are founded at universities.").

In the first minutes, the teacher presented basic knowledge regarding the importance of university spin-offs. In order to emotionally engage the audience, the speaker introduced three fictitious and allegedly highly effective drugs that targeted cancer, yellow fever, and chronic pain. After praising the technological and medical achievement epitomized by these drugs, the speaker revealed to the audience the fictitious nature of the medications and emphasized the importance of research and development conducted by pharmaceutical (startup) companies. Throughout this first part of the seminar, the speaker used activating language, e. g. phrasing questions like "Think very hard for a second. What do these three drugs have in common?"

The second part of the seminar focused on opportunities and risks associated with starting a business. To create a contrast with the style of the first seminar part, the speaker resorted to a less engaging lecture style. At the end of the second part, key takeaways were summarized on one slide and in clear, concise language. The third part discussed personality traits associated with entrepreneurial activity and entrepreneurial success. To activate the audience, the speaker conducted three online whiteboard exercises (e. g. on a time line,

participants had to pinpoint what they believed was the five-year survival rate of startups in Germany). In between each activating exercise, the speaker summarized extant theoretical knowledge.

Finally, in the fourth part, participants reviewed the necessary steps to found a startup using a simulated business case. To this end, seminar participants were engaged in an intense 10-minute whiteboard exercise and was asked to come up with a fictitious startup and write down the assets and requirements for this fictitious startup. The speaker concluded the seminar with a short summary of the typical milestones of a nascent/early-stage startup.

At the end of the course, participants were asked to evaluate the transparency of the learning objectives, the structure of the course, how comprehensible the delivery of learning content was and whether the activation of students was appropriate (on a scale ranging from 0 to 5). In addition, students were asked two questions regarding their interest in a future entrepreneurship seminar (“Was the seminar relevant to me in terms of content?" and "The relevance of the content justifies the expansion to a one-day seminar.").

Particular emphasis was put on overcoming the challenges associated with the online format of the seminar by employing different techniques developed during the teaching workshop “Qualifikation in der Lehre”. Such techniques included 1) creating a proper learning atmosphere (friendly atmosphere applying the principles of emotional leadership), 2) communicating in a clear, distinct, and calm language with an emphasis on clear structure, 3) using and constantly monitoring a chat function to invite students’ questions, 4) optimizing camera settings (showing the teacher on a monochrome background without distracting features, wearing a contrasting white shirt, ensuring proper alignment of the teacher’s silhouette, presenting clear and visually appealing slides), 5) making emphasis on goals and takeaways using goal/takeaway slides after each topic or chapter and 6) frequently interacting with the students as described in the sandwich principle (Kaufmann & Eggensperger 2017: 47–60) using poll and whiteboard functions.

In addition to the course feedback, short interviews were conducted with the student participants to record any additional feedback. Both students rated the course in the highest category regarding transparency of learning objectives, clear structure of the course, comprehensible delivery of learning content and appropriate activation of students. In addition, both students answered that the seminar was highly relevant in terms of content and that the relevance would justify the expansion to a one-day seminar. As mentioned before, the seminar was further evaluated by one member of the quality management team for medical education and a senior faculty member at Heidelberg University Hospital. The feedback from both parties was positive, i. e. both deemed the seminar to be of sufficient relevance and interest for future medical students to be expanded into a one-day seminar. In addition, all teaching techniques listed above and without exceptions were considered appropriate for an extended online seminar.

Given the small sample size (only two students participating in the study) it was not possible to draw any conclusions related to the general medical student population in Germany, especially in the absence of any literature data on entrepreneurship teaching in German medical schools. Niccum and colleagues, however, studied the prevalence of entrepreneurship courses in US medical schools (NICCUM ET. AL. 2017; 158 medical schools were studied) and showed that the number of entrepreneurship courses had increased from 2 to 13 between 2007 and 2016, suggesting rising interest in entrepreneurship teaching among medical students. Taken together the authors hypothesized that medical students would be willing to invest time in a one-day, extra-curricular seminar dedicated to entrepreneurship based and devised a proof-of-concept experiment which will be outlined in the following chapter.

Design and implementation of the proof-of-concept study

The authors designed their proof-of-concept study with the purpose of demonstrating that a one-day, extra-curricular seminar conveying basic theoretical and practical entrepreneurship knowledge and involving medical students is feasible. In addition, the authors sought to proof that participating medical students can perceive this seminar as a positive, productive learning experience.

For the conception of the proof-of-concept study, two key challenges were addressed. First, the authors assumed that course participants would have little to no prior knowledge regarding entrepreneurship and thus, the one-day course would have to summarize, in a short time, the most important information related to entrepreneurship, entrepreneurship's role for the economy and society, economic policies, and entrepreneurial personality traits. In addition, course participants would require need enough time to familiarize themselves with the topic and at their own pace.

The second challenge was how to teach the practical elements of entrepreneurial activity, which is highly dynamic and creative in nature. Specifically, startups all over the globe have embraced the so-called lean startup approach (RIES 2017). The lean startup framework is described as an out-of-the-building approach encouraging startups to spend less time with product development but rather to generate rough prototypes early in the development process. These prototypes are presented to prospective customers/users in order to receive feedback that will guide future iterations of product development. Incorporating the lean startup concept into an online seminar was seen as a major challenge, since students would need to be able to produce a first product prototype in a short time frame and with minimal tools/material. Furthermore, they would have to interact frequently with potential users/customers to gather feedback.

To overcome the first challenge on how to convey entrepreneurship knowledge in a short time frame, a decision was made to develop an extensive pre-course primer that would serve as a foundation for the one-day seminar. The content of the pre-course primer would then be summarized again in that seminar in the form of a refresher so that students would increase storage

of information by activating prior information (KAUFMANN & EGGENSPERGER 2017: 71–85). In addition to creating a common level of knowledge, the pre-course primer would help the audience to familiarize itself with the topic and at their own pace. This, in turn, would allow the seminar's teacher(s) to focus more on practical exercises related to entrepreneurship.

For the pre-course primer, the authors employed a podcast series that digests and summarizes some of the most relevant insights gained by entrepreneurial researchers. This podcast series was developed by the authors and in collaboration with Mannheim Business School and the startup ecosystem Next Mannheim to address a broad lay audience.

Altogether, five podcast episodes (approximately three hours of audio material) were compiled by the authors and voiced-over by a professional voice actor.[1] Chapter 1 addresses general questions, such as the startup failure rate in Germany and industry-specific failure rates. It further touches upon factors connected to startup failure and success, and summarizes how failing affects health as well as personal life. The second chapter discusses whether anybody can be an entrepreneur, whether being an entrepreneur can be learned and which personality traits are linked to entrepreneurial activity and to entrepreneurial success. Chapter 3 discusses intellectual property and patent application filing in Germany. Chapter 4 focuses on the economic contribution of startups and on their general contribution to German society. Finally, chapter 5 addresses entrepreneurial policies and discusses research on the effectiveness of existing policies as well as recommendations from leading entrepreneurship researchers. All podcasts were uploaded to a commercial webserver and made available to the students prior to the one-day seminar. The learning objectives included being able to describe entrepreneurship's main role for the economy and for society, being able to explain the major economic startup policies, and being able to name the most important entrepreneurial personality traits. Students received access to the pre-course primer audio material one week prior to the seminar (figure 1).

To address the second challenge (related to teaching the lean startup method) an interactive teaching model was chosen and adapted (the original teaching model was presented by Prof. Alexander Hahn during his course on customer-centric innovation at Mannheim Business school in 2019/2020). Students were asked to use www.mockplus.com, which offers a large variety of layouts that can be filled with easily customizable and interactive components. www.mockplus.com was chosen because it would enable participating students to build a first product prototype quickly, without prior knowledge and without requiring anything else than internet access on a mobile phone. The link to the prototyping tool was released one day prior to the seminar. Figure 1 outlines the seminar structure as well as the pre-seminar activities which will be described in more detail here.

On the day of the seminar, the instructor kicked off the seminar with an introductory session that was analogous in content and in setup to the 30-minute seminar described in the chapter "Previous work leading up to proof-of-concept study" and reviewed the most

[1] Example accessible through MANNHEIM BUSINESS SCHOOL 2021. https://www.youtube.com/watch?v=7zDVbGHd8Ko.

relevant theoretical entrepreneurship knowledge. Students were then introduced to the contents and to the learning goals of the interactive teaching model described above and were further introduced to the concept of lean startup in a short 10-minute input. After a 15-minute break, students were given 30 minutes for ideation and 45 minutes to conceptually develop an app prototype using the mockplus website. The app should solve a relevant customer need but there were no restraints in terms of app topic and target customer choice. After a short break, students were asked to go outside and show the prototype to at least five randomly chosen pedestrians and to incorporate their feedback into the app prototype. Students were asked to complete this final task in 90 minutes. After a subsequent 15-minute break the teacher closed the seminar summarizing the main take-aways and answering questions. After the course, students were asked to rate the one-day seminar and to evaluate the transparency of learning objectives, clear structure of the course, comprehensible delivery of learning content and appropriate activation of students. In addition, each of the students was contacted the day after the seminar for a short feedback interview.

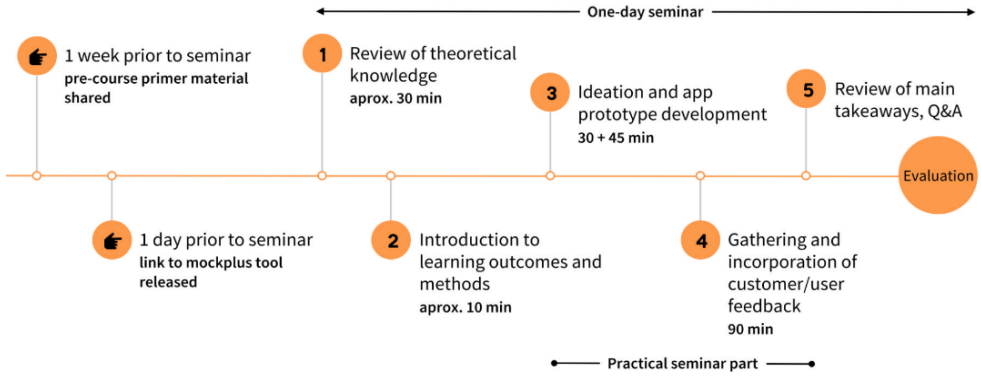

Figure 1
Seminar structure overview

After completion of the course, students should be able to name the benefits of the lean startup approach. Students should ideally gain this insight through their practical learning experience. The learning objectives included being able to identify a specific target customer, isolating a key pain point specific to that target customer and developing a simple, clickable app prototype. Table 1 summarizes the course's content, topics and learning goals.

	Content	Topics	Learning Goals
Pre-course primer - podcast 1	40min podcast	Startup survival and failure	1) Being able to describe entrepreneurship's main role for the economy and for society, 2)being able to explain the major economic startup policies, and 3) being able to name the most important entrepreneurial personality traitsbeing able to describe entrepreneurship's main role for the economy and for society
Pre-course primer - podcast 2	40min podcast	Personality traits of entrepreneurs	
Pre-course primer - podcast 3	30min podcast	Intellectual property and patent application filing	
Pre-course primer - podcast 4	40min podcast	Economic/societal contribution of startups	
Pre-course primer - podcast 5	40min podcast	Entrepreneurial policies	
Seminar - theoretical part	Seminar	Review most relevant theoretical entrepreneurship knowledge	
Seminar - practical part	Practical exercise	Lean Startup approach	1) Being able to identify target customers, 2) isolating their key pain points and 3) developing app prototype

Table 1
Course content, topics and learning goals

Results of the proof-of-concept-study

Three medical students enrolled at the University of Mannheim (n=1) and at Heidelberg University (n=2) participated in the one-day seminar. All three students had collaborated with one of the authors (B.C.) in separate research projects and had not participated in the pilot seminar. As with the previous pilot seminar, they were specifically recruited for this experiment because they had not been engaged in any entrepreneurial activity prior to the interview and were living in the local ecosystem.

Two students rated the course in the highest category (5 points on a scale of 5) regarding transparency of learning objectives, clear structure of the course, comprehensible delivery of learning content and appropriate activation of students. The third student rated the course in the highest category (5 points on a scale of 5) regarding transparency of learning objectives, clear structure of the course, and comprehensible delivery of learning content but only rated the appropriate activation of students with 3 points on a scale of 5 (**figure 2**). In addition, all three students answered that the seminar was relevant in terms of content and approved of the online format as well as the length of the seminar.

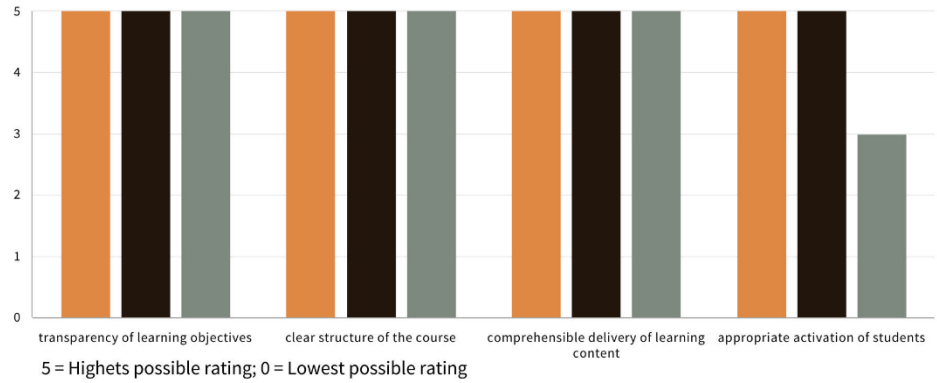

Figure 2
students' evaluation of the course

One of the students mentioned in their interview that his predisposition to found an own startup had strongly increased after the seminar, especially due to the interactive prototyping experiment. However, one of the students, having rated "appropriate activation of students" with 3 points on a scale of 5, described that they had perceived the exercise as particularly stressful. All three students described the activation during the prototyping experiments using keywords such as "intense", "stressful" and "fast-paced".

All students praised the pre-course primer as a valuable asset to the course, but two out of three students suggested shortening the length of individual chapters to a more bite-sized length of around 10-15 minutes each.

Altogether, this study serves as a proof-of-concept that a one-day seminar conveying relevant theoretical and practical entrepreneurship knowledge to medical students is feasible. In addition, the authors could show that participating medical students can perceive this seminar as a positive and enriching learning experience. Based on the participants' interviews, the seminar might be well suited for students without experience in entrepreneurship.

The online format of the course was well received and made it simple to include pre-course primer material to benefit students' knowledge formation. The online format did not seem to constrain the prototyping experiment, i. e. students were able to interact with customers/users and to gather prototype-related feedback despite the short seminar duration and despite the online format of the course.

From proof-of-concept to a concept for a future entrepreneurship seminar

Based on the proof-of-concept study, the authors set forth to develop the concept for an entrepreneurship seminar that could be integrated into the broader medical curriculum. To this end, they presented insights gained from the proof-of-concept study to medical students as well as to relevant startup ecosystem stakeholders in order to incorporate potential feedback into a final seminar outline. Feedback from students and stakeholders will be briefly summarized here, followed by an outline of the final seminar concept.

The authors first interviewed three representatives from the student council at the medical faculty of Heidelberg University as well as an additional medical student enrolled at the medical faculty at the University of Münster. In addition, and to complement these views with insights gained from business students, short qualitative interviews were conducted with eight randomly chosen business students enrolled at the University of Mannheim. This last cohort was interviewed in the hope of understanding general requirements that business students would pose to entrepreneurship teaching.

Interestingly, and contrary to initial findings, medical students recommended to conduct the seminar in person and ideally, within the facilities of the startup ecosystem. Students argued that this shift in mindset was mainly due to the effect of the long-lasting COVID-19 pandemic which had shifted student's preferences towards on-site activities.

To avoid conflict with the medical curriculum, it was further recommended not to conduct the seminar during the week or in the late afternoon/evening as this would severely impact students' engagement with the topic. All students approved of the idea to receive the lecture in English, given that English is the predominant language in the startup ecosystem.

A recurrent request was that an entrepreneurship seminar for medical students would also serve as a venue to connect with students from other faculties, specifically with business students. When asked about their knowledge of the Rhein-Neckar startup ecosystem, students from Heidelberg University lamented a lack of information in this regard.

Finally, students were asked if the seminar should be conceived as compulsory or a non-compulsory course. All four students recommended incorporating the seminar into the course curriculum. Furthermore, representatives of the student body suggested to incorporate the seminar into the elective track at Heidelberg University. This so-called "Wahlfach-track" track offers students the opportunity to take courses that go beyond the traditional medical curriculum while still earning ECTS points for their medical studies.

Insights gained from business students at Mannheim University were complementary to findings gained from medical students. In a semi-structured approach, students were asked how the local startup ecosystem could prepare students for engagement with startups both as an employee or as a founder. Several critical issues were raised pertaining the current teaching approach at their university: The eight students interviewed explained that there is a lack of cross-pollination between disciplines, which is hindering their capacity for learning outside traditional delivery methods. In addition, all students criticized the lack of access to stimulating practical exercises, a situation which, in their opinion, did not foster creativity

or critical learning experiences, limiting their ability to establish foundations within Mannheim's community setting. It was further perceived that the prevalent focus on theoretical learning had not adapted to students' new learning desires post-COVID-19. Consequently, students further lamented their lacking skills to develop a startup. When asked about basic concepts required to build a startup, such as a business plan, market analysis and lean, customer-centric and service design-driven approaches, business students only revealed a superficial understanding of these concepts. Strikingly, students were unaware of the abundant startup resources available in the startup ecosystem. Finally, four students mentioned that because of their lack of practical skills, and access to individuals with complimentary skill sets they would prefer to work in a well-known company first, with the aim to develop these lacking skills, before then starting an own company.

Taken together, both medical and business students located within the same startup ecosystem were largely unaware of abundant resources within that ecosystem. They reflected on their lack of critical skills to build a startup and at the same time, expressed a desire for practical learning and cross-pollination among disciplines/faculties.

In a final step and to include feedback from relevant stakeholders, the authors contacted representatives of the local startup ecosystem. Three senior representatives of key-stakeholders within the startup ecosystem (Next Mannheim, Technologiepark Heidelberg and Mannheim Business School) were asked for feedback. When presented with the concept for the entrepreneurship seminar, all three expressed interest in the concept and acknowledged the value of such a seminar. Specifically, it was recommended to move medical students out of their common learning environments and teach the seminar on the premises of local startup hubs. This would not only move medical students into a highly stimulating environment but also put them in contact with startups. All three representatives recommended connecting the seminar to the many pre-existing accelerator programs for life science/medtech startups to allow nascent entrepreneurs a direct transition into the startup ecosystem.

Finally, one additional Next Mannheim representative recommended that during the practical learning experience of the entrepreneurship seminar, teacher(s) should connect the principles of lean startup with two additional concepts, namely service design and customer-centric innovation. Focusing on lean startup alone, the representative reasoned, had proved to encourage little reflexivity and critical reflection during project development, as users rely on the "Build-Measure-Learn Loop" dogmatically. This manifests with entrepreneurs treating the product as though it is "in a vacuum", separate from the larger context and the real-life experience of its users, as most lack a process for discovering their markets, locating their customers, developing the market, verifying the business model, and growing their business. Based on all the detailed feedback gathered from students and stakeholders, the authors generated the final outline for an entrepreneurship seminar.

Final framework for an entrepreneurship seminar and outlook

Based on the proof-of-concept study and detailed feedback described in the previous sections, the authors conceived a first outline for an entrepreneurship seminar that could be offered within the compulsory curriculum. The seminar outline will be briefly summarized below.

Course length: 8 hours, spread over 2 days, ideally Friday afternoon (half-day course) and Saturday (full-day course).

Course format: Physical event to better match students' post-COVID expectations, allow for a close physical proximity with med-tech startups and immerse students in the Rhein-Neckar Startup ecosystem. The course will be held in English to acclimate students to the predominant startup/business language.

Course participants: To foster the cross-pollination between medical students and students from other disciplines, the course will invite students from a local business school to participate in this seminar in addition to medical students.

Course content: The course will include a pre-course primer, consisting of five bite-sized podcasts sessions summarizing important knowledge gathered from entrepreneurship research. In addition, students will be introduced to the local startup ecosystem both in terms of the key actors and the main resources for early-stage startups. Emphasis will be put on mapping the ecosystem and naming the contact people for relevant stakeholders in order to reduce bureaucratic barriers and convey a comprehensive picture of the startup ecosystem. The second part of the course will focus on a practical learning experience centered around some best-practices for startup conception: to best prepare students for entrepreneurship, the pilot program will combine lean startup methodology with service design tools, as it offers a replicable framework that activates holistic development to achieve the aim of building for co-creation.

Learning outcomes: Students should be able to name key benefits of entrepreneurship for economy and society as well as the main focus and vehicles of economic policies to foster entrepreneurship in Germany. Students should be able to name the three most prevalent entrepreneurship traits and be able to recapitulate basic facts about startup survival. Finally, students should be able to name the main protagonists in the Rhein-Neckar startup ecosystem and to know the three most relevant funding vehicles/accelerator programs for nascent/early stage startups. In addition, students should be capable of explaining the three basic concepts of customer-centric innovation, lean startup and service design. In terms of practical knowledge, students should be able to ideate, build from identified needs and test a simple app-based service using a non-coding platform. Finally, students should be able to correctly identify customer needs from short customer interviews and be able to describe basic concepts pertaining to market research and business models.

The authors intend to test this seminar in the upcoming months with a first cohort of participants recruited among students at the medical faculty of Heidelberg University, Mannheim Business School and Mannheim Technical University. The authors believe that

in the Rhein-Neckar region, which is home to one of the most vibrant national startup ecosystems and is a beacon in the medical (research) landscape, universities will be the neutral ground in which all the ecosystem's parts can come together and shape tomorrow's entrepreneurs at the crossroad between medical research and patient care. Since the vast majority of founders of innovative companies attended a university, it is important to see universities as key environments for the promotion of entrepreneurship. The authors believe that implementing entrepreneurship teaching for medical students will not only serve to foster patient care but that it may also contribute to the formation of highly innovative startups.

Acknowledgements

The authors are highly indebted to the numerous parties that helped to continuously shape the abovementioned seminar concept. In particular, the authors would like to acknowledge all the students who participated in the numerous interviews and in the proof-of-concept study as well as students from the student council at the medical faculty of Heidelberg University (working group "AK Digitale Medizin"), representatives from the medical faculty of Heidelberg University, Mannheim Business School and Mannheim Technical University as well as representatives from Next Mannheim, CUBEX ONE and Technologiepark Heidelberg.

Bibliography

ÅSTEBRO, T., BAZZAZIAN, N. & BRAGUINSKY, S. 2012. "Startups by Recent University Graduates and Their Faculty: Implications for University Entrepreneurship Policy", in: *Research Policy 41: 4,* S. 663–77. https://doi.org/10.1016/j.respol.2012.01.004.

FRITSCH, M. 2019. *Entrepreneurship: Theorie, Empirie, Politik.* Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-662-57984-8.

KAUFMANN, D. & EGGENSPERGER, P. 2017. *Gute Lehre in den Naturwissenschaften: Der Werkzeugkasten: Einfach, Schnell, Erfolgreich*. Berlin, Heidelberg: Springer. https://doi.org/10.1007/978-3-662-55520-0.

NICCUM, B. A., SARKER, A., WOLF, S. J. & TROWBRIDGE, M. J. 2017. "Innovation and entrepreneurship programs in US medical education: a landscape review and thematic analysis", in: *Medical Education Online,* 22:1, S. 1360722. https://doi.org/10.1080/10872981.2017.1360722.

RIES, E. 2017. *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses.* First international edition, New York: Currency.

ROBERTS, E. D., MURRAY, F. & KIM, J. D. 2019. *Entrepreneurship and Innovation at MIT: Continuing Global Growth and Impact—An Updated Report.* Foundations and Trends® in Entrepreneurship, vol. 15, no. 1, pp. 1–55.

Online References

MANNHEIM BUSINESS SCHOOL, Mannheim University. 2021. Unicorn Factory´s Podcast 01 – „Failure" (https://www.youtube.com/watch?v=7zDVbGHd8Ko; last accessed: 17.11.2022)

MOCKPLUS SOFTWARE CO. 2022. "Mockplus" (https://www.mockplus.com/; last accessed: 08.12.2022)

Bria Rose Jammali-Versace was trained in Industrial Design at the Royal Melbourne Institute of Technology. She is now completing her Master's degree in Product Service System Design at Politecnico Di Milano. As a designer, she focuses her efforts on design for social impact and the creation of new knowledge within the Service Design sphere.

Bria Rose Jammali-Versace
briaversace@gmail.com

Benito Campos was trained as a neurosurgeon and medical researcher at Heidelberg University Hospital. As physician, scientist and entrepreneur, he constantly explores ways to connect his experience as academic lecturer with his background in business administration.

PD Dr. Benito Campos
b.campos@young-alliance.org