Digitised lifelong learning – the need for interdisciplinary sustainability modules in doctoral programmes

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ABSTRACT

Ensuring long-term qualified employees and specialists is a key objective of a sustainable development and lifelong learning. At the same time, international competitiveness and technological capability is mainly connected to the countries’ education and science systems as well as of academia.

Major industrialised countries such as Germany, for example, have recently increased their efforts to implement sustainably and institutionally lifelong learning courses at higher education institutions (HEI). In particular, creating offers for new target groups such as persons with family or care responsibilities, job-returnees, dropouts or experts are addressed. A main focus is the development of interdisciplinary courses in engineering and natural sciences in order to ensure the availability of skilled workforce during the transformation towards green economy.

Therefore, strategies and (business) models for a sustainable, long-term implementation of part-time study and further education offers for new target groups at universities are still largely neglected. In addition, the adequate design of new and further development of existing qualification structures, curricula, modules, advanced study and specialised courses as well as the integration of digital (interactive) contents are accompanied by new challenges that have been largely ignored by research so far. So, both, fostered sustainable implementation of programs on an institutional basis and the subject-specific topic of sustainability is becoming increasingly important within the scope of interdisciplinary offers and courses. Moreover, new working and living environments need innovative and digitised learning backgrounds and conditions. However, a brief comparison between Germany, Austria and Switzerland, for example, reveals strong differences in the types, scope and degree of implementation at present.
So a bunch of questions is still unanswered: How do innovative, interdisciplinary and part-time study platforms and programs have to be designed, structured and implemented? Which prerequisites, framework conditions, (quality) criteria and design forms are specifically relevant for advanced training courses and platform contents in engineering and natural sciences? Which subject-specific and cross-disciplinary competences as well as knowledge must be imparted to new target groups taking into account rapidly changing requirements in professionals’ social environment (e.g., labour market; product, service and technology management)? How can such innovative lifelong learning opportunities be designed allowing for increasing digitization efforts?

Our research involves benchmark analyses, surveys and expert workshops in order to derive systemic, organizational and individual criteria and elements for the design and structure of sustainable, interdisciplinary further education programs and study platforms. Their characteristics will be illustrated using a three-level model. In addition, the effects of an increasing digitization of lifelong learning are to be analysed and specific methodological and didactic concepts are to be developed (e.g. blended learning). On this basis, recommendations for the flexible design, implementation and quality assurance of continuing education and training offers are derived. These results are developed in close cooperation with experts and decision-makers from politics, education/science and business in order to ensure a high level of practical applicability of the research findings. At the same time, the research is expected to strengthen the positioning of universities involved in international comparison.

**Keywords:** Learning and education for sustainable development; Lifelong vocational and scientific continuing education; Permeability between educational systems of vocational and academic education; Innovative educational offers; Digitisation of the higher education sector

1 INTRODUCTION

We are living in a very fast changing world. Further education will become an important and fixed part in the educational landscape. However, several challenges, requirements and demands are linked to further education and life-long learning. Digitisation in education has already affected and will continue to affect different stages of both: our teaching and learning processes (Arnold et al., 2017). Digitisation refers to curricular as well as extracurricular activities at different educational institutions to encourage learners to use all existing digital educational resources. These processes require an effective and sustained change not only in technological possibilities, kind of teaching material, new forms of didactical problem-solving processes, teaching abilities of the stuff, learning and self-management abilities of the students but also in the organisation of the whole educational process and perception of the educational requirements by different stakeholders and developing a digital culture for all parties.

It is also very important for educational institutions to become flexible in order to react quickly to new demands of society and students. It is important to introduce lean management in developing new offers for the students, in developing new programmes and courses – not only
the content has to be up-to-date but also the delivery time should be short. By developing new courses, we have to keep in mind the increased demand and the need for flexible studying and learning at university. This is vital to enable students arranging their lives in a better way according to all different impacts from outside and from their personal lives and in this way to help them to study in a well-balanced environment. In addition, this is also important to attract new target of students – not only traditional ones, but those who are eager to learn in a convenient and comfortable environment enabling them to combine all the responsibilities, like families, children, jobs and other activities with studying. Enabling them to flexible design of their curriculum, their learning speed and studying times.

Ensuring long-term qualified employees and specialists is a key objective of a lifelong learning and the lifelong learning is a precondition for sustainable development. At the same time, international competitiveness and technological capability is mainly connected to the countries’ education and science systems as well as of academia. With fast changing requirements of the modern world and continuing striving for the “further” and the “better”, further education has to expand and offer different ways and different types of degrees, including doctoral programmes.

With the research and development project Open Engineering 2 an open and interdisciplinary engineering education up to a doctorate is to be made possible. Open Engineering 2 faces among others two main questions for successfully establishing a structured interdisciplinary doctoral programme in the context of further education:

1. Which success factors are necessary to establish the support / interaction concept in the context of the development of the interdisciplinary doctoral programmes?

2. How can a scientific theoretical, methodical and systemic understanding and viewpoints be meaningfully combined in interdisciplinary modules/curricula?

In order to answer them, a first benchmark study was conducted; and preliminary results will be presented. However, the next chapter describes the background and theoretical framework.

2 THE MEANING OF INTERDISCIPLINARITY, SUSTAINABILITY AND SYSTEMIC APPROACH

In our very fast and constantly changing world a number of topics affect professional lives. Beside the institutional organisation of further education and instructional design the main issue is content (Arnold et al., 2017). A multidisciplinarity attracts all, but in different processes involved groups, like students, lecturers, employees and managers. It arises from the need to get a new vision of the same object from another ankle and from new research developments. It is getting obvious that there are so many subjects from different fields that interact with each other, influence each other, depend upon each other and complement each other and therefore cannot be seen and taught as separate ones but have to be combined to nourish...
each other to enable the further spreading of existing knowledge and the better and the whole view on all processes.

This kind of approach is especially of interest in programmes and courses for the future managers and global actors (over-lookers): those who want and need to deal and approach to a subject or activity on the whole, entirely all of the processes, throughout the region and worldwide. The need for treating engineering, natural sciences from the economics perspective and vice versa and for defining the relationships and emphasizing the connections between different subjects is obvious and can be achieved in specially designed inter-, multi- and transdisciplinary\(^1\) courses for future employees with managerial tasks. A focus on systemic approaches is of pivotal importance. System-oriented concepts emphasise the self-organisation and self-dynamics of systems (Arnold, 2017). The special gain of systemic approaches is based on a different point of view because they can demonstrate phenomena presented in a shortened, insufficient way or not at all in a linear-causal view. Systems theory focuses superficially on self-organisation, patterns and complex structures, in addition to emphasising the relationship of the single elements among one another (Bestehorn, 2001). In that sense, the quality and the specific nature of the relationship are of particular interest. The latter can be described as interactions and shows that system elements do not exist in isolation but influence one another, and thus a so-called recursivity arises (Vogd, 2005). Interaction processes are therefore circular, or they or reverse and complicate or hamper clear cause–effect classifications. The clear significance of systemic perspectives can be seen in the superposition of several logical chains and levels of description. In general, it is crucial to distinguish different levels having an influence on the current situation or problem as well as on the solution (Arnold, 2017). As in business contexts, people are part of the main transaction and exchange processes; there is always a personal level that plays a role. Yet, beside the personal issues, there is an organisational level as well as the more complex system level, because there are much more moderating factors and interrelations. In addition, the ability to distinguish systemic-complex contexts from cause-effect-relations is crucial for sustainability challenges.

The Agenda 2030 addresses also Education for Sustainable Development. This Agenda was the powerful signal towards active introduction of the academic approach to the questions and issues of sustainability. Among the principles of sustainable development are shaping, managing, producing and living within human systems in such a way that the ecological and social limits of carrying capacity are not exceeded (Allianz Sustainable Universities in Austria, 2014: 6). The Earth’s ecosystems must be unharmed in their assimilation, buffering and regenerative capacity. The configuration of socially and economically more resilient systems

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\(^{1}\) Nicolescu, 1997, defines a “Multidisciplinary Research” as the situation when a subject of research is shared by multiple disciplines”. Referring to this definition the multidisciplinary education applies to education that is focused on multiple disciplines. Interdisciplinary refers to just two interacting disciplines and “transdisciplinary” comprises different disciplines across one topic or related issues.
is linked to this too (Arnold, 2017). Accordingly, recognising, understanding, analysing, evaluating and creating sustainable contexts are of pivotal importance. Sustainability science is based on human, individual and societal norms and values, as well as their reflection, and addresses normative positions for problem solving. Given complex interactions and dynamics, sustainability science aims at linking different forms of knowledge, levels of systems, disciplines and stakeholders in order to find integrative and stable solutions (Arnold, 2017). A sustainable development is based on a whole-society approach where different interests, views and demands are discussed, balanced and realised in a participative way supporting societal learning. According to Barth (2015), both learning and education play an important role.

As Arnold (2017) stated, UNESCO (2014) made clear that a sustainable development and education for all are based on a special quality of education highlighting and communicating both knowledge and fundamental perspectives, as well as attitudes for a sustainable behaviour in all contexts (Mochizuki and Yarime, 2016; Ramos et al., 2015). Wals (2010) sees a new understanding of education, which gives room for discourse, debate and reflection. Since the understanding of education can vary depending on world views, the ideas of man, or humanity, as well as values, Stoltenberg and Burandt (2014) make clear that there is an understanding of the need to deal with these topics in a self-determined way in Western civilisation. That is why academia has such a pivotal importance in the context of a sustainable development. The expansion of sustainability-related values, knowledge and skills belongs to the foundations of an education for sustainable development (Michelsen and Rieckmann, 2014). In particular, Gestaltungskompetenz (the ability to shape the future) is highlighted by UNESCO, for example skills such as forward thinking or the capacity for teamwork or enabling people to assess future decisions (Arnold, 2017). Thus, new courses have been and have to be developed to get the ball rolling on principles of long-term welfare of all nations and all individuals on our planet by focusing on key areas of sustainability in theory and practice, like environmental pollution, global changes, energy and water consumption, agricultural issues and others.

As the programme is being developed in cooperation with Faculty of Mechanical Engineering, the chair for Ergonomics and Innovation Management four basic courses (two from each) and two methodological courses will be offered. The courses comprise topics like Product and Production Ergonomics as well as Corporate Environmental Management and Sustainability. Furthermore, courses on scientific research and methods for collecting data as well as scientific theoretical system logics will be offered to enable the student to work in scientific context. This is also a way to offer a systemic and holistic approach: from the specific – to the general, from business-related topics – to the research-relevant issues, from economy – through engineering - to social issues, keeping always a task identity and the process of vanishing of any boundaries in focus. (Arnold, 2017)
3 METHODS

In order to provide qualitative, demanding, professional, considering the need of modern students, future specialists and business leaders, up-to-date studying and teaching process, the whole methodical approach for designing such courses should be modified and the constraints of teaching and learning as well distinctiveness of life and online learning environments should be taken into consideration.

Effective teaching starts with sophisticated and well-thought-out planning. And at the same time effective planning assumes perfect knowledge of existing opportunities and clear perception of the initial situation. The process of systemic planning, analysing, configuration and evaluation of teaching units is called as “Instructional Design” (Zawacki-Richter, 2017).

Besides the structural quality of the planning and organisation of the course the quality of the content should be assured. Therefore, the literature on the topics of innovation and sustainability has to be examined on international level to find really up-to-date subject-matters and in this way to ensure relevant contemporary and down to present day teaching. It is also important to differentiate and to focus on topics of sustainability and innovation especially for future engineers by squeezing this issue through the engineering lens and applying this subject to engineering environments: engineering of products, organising of industrial processes, planning of industrial factories and managing of industrial companies. This systemic approach is efficient if international data banks are considered and reviewed².

A strategic planning of a new course or model requires a strategic analysing, which consist of market description, market size, market growth, competitors’ analysing and target audience analysis (Breitenberger et al., 2017). Our research involves benchmark analyses, which is a part of a strategic market analysing, starting from regional and national higher educational institutions and going to worldwide universities³, surveys among students and lecturers and expert workshops from both: educational Institutions and industry, in order to derive systemic, organizational and individual criteria and elements for the design and structure of sustainable, interdisciplinary further education programmes and study platforms. Their characteristics are illustrated using a three-level model (local, national, international)⁴. In addition, the effects of an increasing digitisation of lifelong learning are to be analysed and specific methodological and didactic concepts are to be developed (e.g. blended learning). On this basis,

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² A comprehensive list of international literature in form of books and articles issued in peer-reviewed journals is being prepared by using different sources of data banks, like Springer Link. Google Scholar, Scopus, Ebsco Host, Econbinz, Web of Science etc.

³ This analysing is done by comparing of offers on the websites of different HEI in Saxony and worldwide in reference to PhD programmes (s. the abstract above).

⁴ A survey is getting prepared for individuals upon their attitude for lifelong learning programmes, their interests for sustainability issues and their estimation of important issues for successful accomplishment of a PhD-course.
recommendations for the flexible design, implementation and quality assurance of continuing education and training offers will be derived.

Analysing the role of further education at worldwide famous educational institutions and getting to know the huge range of different types of programmes and courses offered at those bodies and departments it gets obvious how important is further education for our society and that it should become an integral part of every educational policy. The always changing world of technology and therefore the world of our work, the world of our society and the world of our living will lead to more flexible attitude to education in general - in terms of choosing and working on absolutely different subjects - and to the importance of permanent development of every one - in terms to constant achievement of constantly changing requirements of the professional and social world. Moreover, these results will be developed in close cooperation with experts and decision-makers from politics, education/science and business in order to ensure a high level of practical applicability of the research findings. At the same time, interviews and discussions of different formats have to be conducted with individuals, who might be possible clients and with companies, who are interested in further education for their staff to find out topics and issues which seem to be very important for them and which are considered as vital for their future business requirements. For this reason we are developing a questioning and survey to be done among future possible “clients” upon different factors, responsible for successful implementation of the projects, such as importance of academic degree offered by a course, a qualification of a lecturer, reputation of a university, infrastructure, internationality of a programme or general criteria for choosing a professional further education opportunity (Tu, Nielsen-Lange, 2017). In this way to ensure the acknowledgment of practical importance and closeness to real business surroundings. Simultaneously, the research is expected to strengthen the positioning of universities involved in international comparison.

The next section presents the first results gained by a benchmark and market analysis conducted from May 2017 until April 2018. The subsequent steps (e.g. survey) will be continued during 2018.

4 FIRST RESULTS OF THE DEVELOPMENT OF NEW DOCTORAL PROGRAMMES AT CUT

4.1 BENCHMARK ANALYSIS

The inevitable ambition to implement and to use digital tools for education and a need for new approach to education in form of a lifelong learning have resulted in increasing efforts to
implement sustainably and institutionally lifelong learning\(^5\) courses at higher education institutions (HEI) by all major industrialised countries such as Germany. On a local level, just analysing Saxony as a Federal State, we can assert that most of the HEI offer mostly bachelor or master degrees on different management topics. Yet, the focus on sustainability is missing completely, and mechanical engineering appears very seldom. PhD-programmes, however, are offered mostly by private educational institutions. The courses vary from strategic management to innovation and entrepreneurship, but do not include any engineering or environmental issues. On the national level, only one university in Germany, the University of Goettingen, offers a PhD in the context related to sustainability and engineering: environmental informatics. If we consider international universities worldwide the situation appears much more interesting and more complex: in the USA there are more than 200 PhD-Courses in Great Britain – more than 100. Our neighbourhood country, Austria offers 23 PhD programmes and in Switzerland one can choose between 40 possibilities to get a doctor-degree\(^6\). Checking the subjects of offered courses reveals that there are about 200 different PhD courses related to engineering, like Engineering systems Management, Chemical Engineering, Industrial Engineering etc. Inquiry on the topics of Sustainability on the website offering PhD-Studies worldwide reveals just 8 strikes, which is comparing to other subjects extremely few: PhD in Sustainability at Rochester Institute of Technology (USA), PhD in Geological Science and Ecological Sustainability at Northern Arizona University (USA), Professional Doctor in Education with focus on Sustainability, Equality and Diversity at London South Bank University (UK), PhD in Education with focus on Educational Sustainability at Nipissing University (Canada), PhD in Ecosystem Biology and Sustainability at at Queen’s University Belfast, PhD in Management - Innovation, Sustainability and Health, PhD Programme in Politics, Human Rights and Sustainability at Scuola Superiore Sant’Anna (Italy).\(^7\)

Surely, some other new courses are introduced to the learning-eager community every year to reflect the interests and the need of modern society but the general trends and lacks are visible upon this investigation of today’s situation: we are at the beginning of two big drifts: the increasing importance of the topic of Sustainability and of the issue of interdisciplinarity in terms of a good mixture between engineering, economic and social issues. A brief analysing and comparison of offered lifelong courses at Saxon Higher Education Institutions as well as famous universities worldwide reveals some differences in the types, scope and degree of implementation such programmes at present: different target groups are addressed, such as undergraduates, postgraduates, pensioners. Different educational formats are offered: from

\(^5\) The importance of lifelong learning was also known in the ancient world (Confucius, Hippocrates, Pythagoras, Platon, Seneca) and one of the famous sayings by some politicians at the beginning of the 20th Century, like W.I. Lenin, was “Learn as long as you live”, but the energetic discussion of an active perception of the importance of such attitude goes back to the Seventieth.


Bachelor, Master Degree till Certificates for Higher Education, which legal status and possible value for further studies or for professional achievements are still unfortunately not really defined.

However doctoral programmes are very seldom offered as a possible format for further education and this is exactly the form that is at least represented at further education institution but which has an enormous potential capacity. By evaluating the courses offered by Saxon and worldwide universities we could identify the rising importance of the topic of Sustainability and at the same time a total underestimation of this topic in curricula for PhD programmes.

But this topic is not only about the environment and saving the planet, it is also about our culture in dealing with such ethical issues and about the responsibility that every institution, company and individual have to assume to reach those goals. It is about managing responsibly to deal competently with the goals for our future. By exploring management practices within a company, you can find different fields where these goals and the issue of sustainable development can be tackled: from Strategic Management - to Innovation Management, from Entrepreneurship – to Organization, from Operation Management – to Supply Chain, from Human Resources - to Communication, from Marketing - to Sales, from Production – to Logistics and Supply Chain, from Accounting – to Finance. And this approach shows that there is no process within a company, no department or division in any institution, which is not affected by the goals of Sustainable Development. And to bring them in a working system together in a way they support each other and don’t seem contradictory is a huge task of such new educational programmes.

Considering all the aspects mentioned above, concerning different trends in society and business, the huge role and impact of digitisation on educational programmes and on the movements towards opening of educational system in various ways to different stakeholders, considering the importance and significance of interdisciplinary subjects and an enormous challenge of our generation to create a sound basis and eventually start working actively on developing sustainable future by learning, teaching and implementing those required strategies and schedules we have to react in a flexible way to the new requirements. To meet all the requirements of modern social, educational and political development, in order to open University for new target groups, to mirror the need of our society and to consider the latest movement on educational field with new digital instruments and on the latest issues for the safer future, green economy and sustainable and responsible management a new interdisciplinary doctoral programme is being developed at Chemnitz University of Technology.8

8 The Project is a part of the studying platform “Open Engineering 2” in cooperation with University of Applied Sciences Mittweida, is financed by BMWF.
4.2 INSTRUCTIONAL DESIGN OF THE PHD-COURSES

As we are working on doctoral programmes which are supposed to be done as part-time study by professionals, specialists and business leaders, it is very important to create the whole instructional design in accordance with the needs, requirements, possibilities and duties of very much in business processes engaged modern students. This design refers to different issues as times and scope of studying, formats of seminars and lectures, types of homework exercises and tests for examinations and general targeting to offer a holistic and systemic approach to all topics, identifying correlations, “cutting points”, influences and interdependency of the topics of sustainability and innovation with different areas, like change management, quality management, knowledge management, integrated management systems, supply chain management, corporate social responsibility and ethics, compliance, strategic, international management, project management and company culture, intercultural communication or even business psychology. Digitisation allows to let the boundaries between fully traditional campus-based face-to-face present lectures and a complete online and distance-learning study – vanish (Zawacki-Richter, 2017). Digitisation and connected with it flexibility of a learning process develops different models and formats for new are learning process.

The first investigations among interested students showed that the most convenient time for part-time students is at the weekend from Friday afternoon – till Saturday early afternoon. This schedule allows the future students to work the way and to the amount they have to and not to be forced to take a day off and at the same time to still have some free time for their families at the weekend and therefore to stay in balance between the working, the studying and their private lives. About 3 present sessions in a term are considered to be excellent to stay in touch with the whole curriculum and the whole study process, as well as with classmates and lecturers and to have their own time for autonomous studies.

To provide efficient learning it is important to understand the psychology of learning. According to “pomodoro technique”, developed by Francesco Cirillo\(^9\) in the late 1980s and outstanding research on the complex relationship between neuroscience and social behaviour, students might concentrate on one issue and type of task only for about 20 Minutes. Therefore, it is important to divide typical lectures of 90 Minutes in at least 3 parts and organise them in such a way that every 20 minutes\(^10\) students have a different kind of work to be done: starting with an incentive, impulse giving lecturer’s speech, followed by creative tasks to be done in a group, which enables everybody in a “slowly-growing” way and in a convenient atmosphere to “touch” and to “approach” the topic, before an open discussion starts on issues and problems of the given topic to find a common solution in a challenging communication, moderated by an

\(^9\) Francesco Grillo is an Italian scientist working on different economic, political and educational issues like smart cities and innovation and “universities of the future”.

\(^10\) With the idea on presenting lectures in “small portions”/ “chunks” agree also some German scientists, like Brodbek, Röseler, Schöne, Mehra, 2017.
experienced facilitator, who is at the beginning the lecturer and later one of the students. This approach enables the students not only full concentration on the topic, creative way of learning but also practising at the same time the abilities to communicate effectively with superiors, colleagues and staff by listening carefully, understanding and conscious applying of non-verbal communication, by learning to be clear and concise, friendly, open-minded and in the end by getting more confidence in their interactions with others. In this way students will also learn to give and receive feedback appropriately, which is also a very important communication skill.

Besides above mentioned short impulse lecture, group and class discussions, some other creative teaching tools can be used in class or as homework: mind mapping, design-thinking, online games, board games, role-games, online videos (MOOCS), online test with self-checking, online tests with peer-review. These digital opportunities offered by modern technology provide a new form of communication, learning and interaction making this pedagogical, knowledgeable and social exchange possible, comfortable and appealing. But to encourage students to actively use this tool and to assure that the quality of this interaction is of the desired level and delivers the expected results, the lecturer has to invest a significant amount of time and energy to create such a useful, open, resource-rich and profitable learning environment, to provide ample opportunities for social interactions, to offer a perfectly working scaffold for different tasks, which encourage students to active usage and to constant implementation in their learning process (Chen, 2007).

Very precisely identifies Olaf Zawacki-Richter 6 different formats of instructional design: present learning, internet supported present learning, blended learning, which can comprise internet supported present learning and internet supported distance learning, traditional distance learning, whereas here print-based learning is meant, internet based distance learning and fully online learning, like online trainings and MOOCs (Zawacki-Richter, 2017). But even this identification of possible formats reveals the importance and necessity of a mixture for formats, for contents and for the kind of learning and teaching processes. Therefore some scientist working and investigating new learning and teaching formats identify just 2 main forms: present phase and online phase, whereas the online phase is very manifold: digitalised studying papers, video lecturers, webinars, chat opportunities, virtual learning environments, automatic quizzes, cooperative online seminars to fulfil the requirements of the generation Y (Dworok et al., 2017).

Some other formats and learning ways as traditional presentation of students’ own results on research for their dissertations and on their own learning-knowledge for special topics and summer schools, which is a completely different medium for the “complete diving” in learning and teaching atmosphere for some days with enormous opportunities of outcome should not be just contracting of content from typical life sessions, but offer some special experiences and opportunities, which differ from other types of teaching events. It can be in form of expert interviews from society or industry and in form of “real-life”-projects.

As for the examination, traditional ways of multiple matching exercises can be used or traditional “questions-answers”-tasks, but it is also important and the time should be taken to
have a personal discussion with the students, because especially abilities to deal with some issues can only be seen through interaction with a student on a personal level. It is crucial for different kind of tests and assessments to be embedded continuously into learning process and not to be used as a check for the set goals at the end of the topic.

Before implementation of the whole programme some test courses with doctoral students at both chairs will be conducted to assure that students have a positive learning experience in the course and are very much satisfied with the form of teaching, kind of exercises and tasks, interaction between each other and the lecturer, with using online tools and platforms for deepening their knowledge and for the exchange with other students and peers. In this way cooperative and collaborative formats of learning will present considerable additional value and contribute to social commitment of students among each other which is also a requirement for successful studying (Brodbeck et al., 2017).

The usage of native mobile apps for studying and learning is a huge advantage especially for employed people, but also for modern generation to combine the learning world with modern gadgets and opportunities and should be considered as an instrument for modernization of the learning and teaching processes (Brodbeck et al. 2017).

It is also important to keep in mind that the target of the doctoral programme is not just to give some information and to arm students with knowledge and by no way to compress the whole content on subjects of sustainability and innovation into some sessions, but to enable them to understand different interdependences and to look over the used horizon, to be able to see the same subject from different ankles, to be able to act flexibly, to go new ways, not to be afraid of doing something wrong, to have fun by experimenting, to enjoy continuous learning of something new, to get to know the ways to acquire the required knowledge and to investigate on the topic and the question to be solved, and in this way to create self-confidence in what they can do and able to do. It is also fundamental not to underestimate the opportunities and importance of learning from each other: this doctoral programme unifies people from different branches with lots of specific, extraordinary, significant, unique and exceptional knowledge. This is a huge opportunity for both parties: the lecturers and the students to profit from that knowledge and experience, to use it to widen their horizon and therefore to implement it as a part in the whole learning environment.

Although we consider as very important for effective teaching and learning a well-done structure of the whole doctorate programme, the importance of flexibility and openness in designing and conducting lectures should be kept in mind. Students should be also given the opportunity to control the goals, objectives, their outcome and the pace of the whole learning process on their own.
4.3 IDENTIFYING AND ATTRACTING NEW TARGET GROUPS

Most of dissertations/PhD works nowadays are done by research staff of the university, who continued working at different chairs of universities directly after their studies. There are very few applicants for dissertation outside the university walls, the so-called external applicants. But especially this type of interested applicants is of a very high value, both for the research and for businesses. Therefore, it is assumed that in the future the type of doctoral candidate can change enormously and rise in favour of those with practical experience. It is also recommendable to have gathered practical experience before starting working on a dissertation, because experience gives one the required objective view on lots of subjects of research and helps in identifying interesting and necessary topics for survey. By working in the industry young people will be able to get better insights in different processes, to analyse and compare what they have learned and what they effectively face in reality. This possibility of comparison and analysis offered by the fact of being outside, staying in business, getting to know another „world“ is a wonderful basis for further research, for new ideas, new visions and new approaches which are possible only if you have these two points of seeing the same object, the same topic, the same challenge. With such background it will be much easier to find an interesting and for different stakeholders crucial topic to work on.

Therefore, the typical way of the future doctoral student will be to go from the university out into industry/economics/companies first to get that precious experience and secondly to combine these two worlds: the educational with the industrial one, the theoretical with the practical one and in this way to guarantee the objectivity and interdisciplinarity.

At the same time the value of such doctoral programmes for the interested will be very much focused on their future professional activities. This type of programmes will contribute to developing new research-oriented management staff. Research oriented means at the same time - innovative. These are the employees of the future who know what kind of new technologies and new approaches are required in the professional work. They are the ones who start working on these new challenges and therefore forward the innovative breakthrough.

There are several reasons for creating such a doctoral programme and four possible types of candidates: interested specialists from business, interested postgraduates, candidates who have already been doing PhDs for several years, candidates from other educational fields.

1) In the region of Chemnitz, although the offer will not limit the geography of applicants, there are lots of mechanical engineering companies with excellent knowledge and indescribable experience in different fields. Those specialists keep so much valuable skills and proficiency, which could be transferred to others, on one hand. On the other hand, they don’t

\[\text{Statistisches Bundesamt, Promovierende in Deutschland – Wintersemester 2014/2015. According to this study 64\% of all PhD students in 2014/2015 have professional relationship with a university, https://www.destatis.de/DE/Publikationen/Thematisch/BildungForschungKultur/Hochschulen/Promovierende5213104149004.pdf?__blob=publicationFile.}\]
know how possessing this knowledge to pass it to younger generation or how to develop their interesting existing assumptions into possible solutions for the known problem. A doctoral programme can help them to start working on their issues, to lead them, to support them to reach their aim and in this way to contribute to society’s acknowledgment.

2) Some postgraduates have really interesting and research-worth ideas and topics, but are not sure how to start, how to write the thesis, what kind of quantitative or qualitative methods and how to use for their scientific work. Those, who would like to get some practical hints for scientific work and who would be glad to get an opportunity to refresh their knowledge in scientific research to get their idea move forward are in need of a professional support.

3) There is also another type of doctoral candidates, who are external PhD students, working in companies, with huge amount of theoretical and practical knowledge, who already have started working on their research project and have finished some steps and even written some paragraphs or chapters but because of different reasons cannot find time to continue their work or to finish it. And they can be interested in doing a programme which helps them to organise the process better and to shorten the time for working on their PhDs.

4) Some possible candidates might have their master degrees in Economics or in Engineering but through working for some years have got experience in another field. The developed course offers the opportunity to those from “foreign” field to get the required knowledge in the programme and to be able to do their PhD e.g. in Engineering without having Master Degree in Engineering. This is a very lucrative opportunity for many professional specialists.

As we have identified the main new target group for our doctoral programmes as those professionals in jobs for some time, those specialists from “foreign subjects”, postgraduates seeking for help in academic research, those - on maternity leave, those with family responsibilities etc., it is important to find the ways to inform them about our courses and to get their interested. Information might be done in different ways: via mass media, with help of job exhibitions and job fairs. But the most effective one could be the direct address of the interested through close cooperation with the Management and personnel department of interested companies and professional unions like VDMA, BDI, BMWI as well as such institutions like IHK/AHK/HHK, who have direct contact to the companies and their requirements and needs. The new target group can be extended by international students: first of all from Austria, Switzerland, but we also may consider the opportunity to attract students from Poland or Czech Republic that are very close to our region or even go further to Russia, Great Britain or South Africa by addressing our partner universities. For this reason, developing of our programme in English language should be taken into consideration to get the opportunity to open it and to offer it to international students and therefore to contribute to the internationalism of all educational processes in the world and to get an international recognition among PhD students from abroad.
Here again a systemic approach in searching and attracting new target groups is of a high importance: demand analysing through individual target groups, potential analysing – through institutional target groups and acceptance analysing through internal HEI target groups (Seitter et al., 2015). It is very much important not to wait too long with implementation of the courses (Seitter, 2018). Very important is the quality but to improve the quality it is important to start implementing the course in practical sessions at an early stage and to get the inputs about issues to be changed, dismissed, added or improved.

5 CONCLUSION: CHALLENGES AND ADVANTAGES AND QUESTIONS FOR FURTHER RESEARCH

The development and the introduction of the new interdisciplinary doctoral programme to the educational society in Saxony, Germany and even maybe one day on international level is a new challenging venture which has a sound foundation for success, because of the uniqueness of this programme, of the social and business demand for this type of education in terms of organisation as well as of being up-to-date topics and if it is done professionally and with high quality again of the external (organisation and planning) and internal (content and methodology) issues, which we target at. The problem to solve is in the digital implementation of all the ideas. It is not only about designing digital platforms and digital scripts, exercises, peer-reviewed tests and other form of innovative teaching. It is also not about equipping of the future students and lecturers with notebooks, smartphones and tablets or any other digital devices or presenting lectures online via video. It is first of all about providing the fully-engaged university staff with digitals skills, which enable them to design, to deliver and to “live” digital learning environments. Universities have to think about creating of new learning experiences and spaces which meet the needs and desires of future students12.

Another big issue is the extent of opening the University for such programmes. And this openness can go in different ways and come from different corners: openness for students with different educational, social, geographic, international background, openness in the whole process of attending different courses and learning and teaching environments and openness in recognition various achievements from different educational institutions among each other.

By offering such innovative, multidisciplinary doctoral programme to “non-traditional” type of students and therefore by opening these educational lifelong learning opportunities to different social groups and by addressing in such programmes topics that “move” the society forward, mirror their requirements and needs, by involving the business and the society into a direct and close dialogue with research, study and the whole educational process, we consider the

interests and values of citizens and this is the basis for increasing quality, social acceptance and sustainability in research and innovation in vertical and horizontal directions.

A bunch of questions is still to be answered: How do innovative, interdisciplinary and part-time study platforms and programmes have to be designed, structured and implemented? Which prerequisites, framework conditions, (quality) criteria and design forms are specifically relevant for advanced training courses and platform contents in engineering and natural sciences? Which subject-specific and cross-disciplinary competences as well as knowledge must be imparted to the new target groups taking into account rapidly changing requirements in professionals’ social environment, like labour market, product, service and technology management? How can such innovative lifelong learning opportunities be designed allowing for increasing digitisation efforts?

These are the questions we are continuing working on and invite other interested and maybe lateral thinkers to solve the problem of lifelong learning desire and need by cooperating on this global, local, innovative, open issue. Digitised lifelong learning courses aim at our entire society: at those who haven’t taken the advantage yet or who haven’t been interested in further education as the culture of further education has been missing and therefore no offers from educational institutions have been there. Digitised learning changed the way we thought about further education before: further education was considered in the past as a sign for missing qualifications and skills. And now it is seen as a very important, necessary and vital tool to get along in our professional and social lives. The approach to the need of further education by all parties: the private people, the society in general, by companies, by politics has changed dramatically and has to be implemented into social and professional natural development. Digitised lifelong learning programmes with their flexibility, variety and convenience open also a door to new target groups such as persons with family or care responsibilities, job-returnees, dropouts. But also, experts in some specific fields are addressed to improve their knowledge and to widen it into other subjects and areas.

With our programme we have to be able and intend to ignite the interest of future students and possible business clients (companies), to develop this interest to their burning desire and to generate the huge demand in the society and in this way to contribute to mutual benefits for the whole community and for personal development of each involved and in this way to provide another way to achieve the seventeen Sustainable Development Goals for better future for the whole planet.

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