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Data Analytics: The Future of Innovative Teaching and Learning

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Abstract*: Due to the digitization new technologies and business opportunities arise that lead to innovative teaching and learning approaches within in schools, universities or companies. EdTech companies evolve and influence the educational systems. Focusing on the perspective of EdTech providers, a qualitative study based on 23 in-depth interviews and desktop research identifies individualization of the teaching and learning journey and a general culture change as main dynamics within education. It turns out that current business models of EdTech providers are either with low data or data-enhanced that data-driven. Furthermore, three levels of integrating data analytics within an EdTech business model are defined to innovate teaching and learning: *Basic Learning Analytics*; *Learning Analytics and Recommendations*; *Learning Analytics and Adaptive Teaching and Learning*. The last level is proclaimed as disruptive innovation which seems more a future scenario as possible reality within the EdTech sector based on the study.

Keywords: Education; EdTech; Innovation; Data Analytics; Business Model; Disruptive Innovation; Learning Analytics

1 Introduction

The rapid development in the digital environment encourages diverse ambivalences, which affect us in almost all areas of life and constantly challenge us in new ways. In the course of an ongoing global drive for efficiency and competitiveness, education and training are now regarded as the responsibility of the post-secondary sector, where pupils, students and adults face a wider set of expectations not only to learn and synthesize subject matter, but to adapt it and put it to use almost immediately. However, digital

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transformation is not only the driver of the lifelong learning commitment mentioned here. Rather, digitalization also offers new opportunities to shape our learning journey. Digitization forces European educational systems to change. Furthermore, companies in all industries have to constantly educate and train their employees to make digital change happen. Numerous studies have already proven the influence and relevance of digital transformation at the individual and at the corporate level. Kane et al. (2015) describe the change in business models due to digitization as fundamental. However, taking a closer look at companies in the education sector, there are hardly any studies on the development of these so called EdTech companies and how they influence the educational system to shift from analogue to digital. Therefore, in this study we focus on identifying new business models in the rising EdTech sector in Europe, with a focus on the provider's perspective. The aim is to understand these businesses and how they developed innovative teaching and learning methods through digital technologies and data analytics. We are thus focusing on the following two research questions:

1. *What are the drivers and barriers of digitization for innovative learning and teaching?*
2. *What's the current and future role of data analytics in the EdTech sector with regard to creating new innovative teaching and learning approaches?*

In the following section we provide a brief literature review (section two) to summarize the innovative teaching and learning trends that have emerged in the context of digitization. The two-stage qualitative research design is described in section three. The fourth section first presents the identified business models, in particular their corresponding value propositions. Based on these results, we highlight the main drivers and barriers for innovative teaching and learning approaches and discuss the relevance of data analytics for EdTech providers. Section five closes this paper with a summary of the research results and the setting of research impulses for subsequent studies.

2 Literature Review

The Global Start-up Ecosystem Report (2018) predicts a global education expenditure growth to $ 8 trillion by 2020. Education is declared as one of the last sectors that innovates with technology, the so-called Educational Technology (EdTech). EdTech is defined as *"the digitization of education services and business models"* by software providers that offer technology solutions for schools, higher educational institutes or companies (Start-up Genome 2018, p. 102). Weller (2018) outlines important technological developments that have shaped the education sector over the past 20 years. Starting with Wiki´s in the late 90s, the development led on to MOOCs in 2012 and large platforms such as edX that have raised just within the last years (Rothe et al. 2018; Weller 2018). Today, innovative teaching and learning methods can be combined with digital technology such as virtual reality, augmented reality or cloud computing and digital media such as images, video or audio (Kalyani and Rajasekaran 2018; Trifilova et al. 2016). These new forms of digital teaching and learning enable people of all ages to decide what, when and how they want to learn – mainly individually, at any time and from any place. Collins and Halverson (2009) already suggested that innovative digital teaching and learning will be determined by three main elements: *customization*, *interaction* and *control*. Huda et al. (2016) went even further and defined big data and analytics as key enabler to enhance innovative teaching and learning based on *individualization* and *interaction*. Furthermore, Bond et al. (2018) propose that the integration of digital technology within the teaching and learning process makes it more *flexible*, *adaptiv*e and *innovative*. However, digital technologies make it possible to

collect data of the teaching and learning process for universities, schools and companies. The analysis of this digital data is defined as Learning Analytics, "*the measurement, collection, analysis and reporting of data about learner for purposes of understanding and optimising learning and the environments in which it occurs"* (Policy Connect, 2016, p. 4). However, the more comprehensive term in regard to data-driven business models and company related processes is data analytics (Hilbig et al. 2018). The infinite possibilities of adaptive learning, which requires the analysis of large amounts of data (data analytics), foster new EdTech companies to refine smart learning tools, algorithms and predictive modelling. Education gets reshaped by the datafication of teaching and learning processes which makes the educational sector market- and customer-driven (Mayer-Schonberger and Cukier 2014; Education Design Lab 2014, Williamson 2018). As a result, EdTech creates new, innovative and smarter teaching and learning models that improve the performance of individuals or whole organizations and lead to new business models in all areas of education, i.e. school, university, vocational training and further education (Startup Genome 2018).

Thus, the business model concept itself became increasingly relevant in the literature but also in practice (Zott et al. 2011; Baden-Fuller and Mangematin 2015; Ritter and Lettl 2017). While there are different perspectives and definitions of the term 'business model' (Ritter and Lettl 2017; Zott and Amit 2010; Berends et al. 2016; Osterwalder and Pigneur, 2010), the most acknowledged definition is from Teece (2010, p.172) who defines a business model as the *"design or architecture of the value creation, delivery, and capture mechanisms"*. Throughout the last years, the main unit of analysis of educational business models were MOOC (Massive open online course) platforms. However, Daniel et al. (2015) emphasize that the MOOC business model is moving from 'freemium' to 'premium', followed by the so-called 'post-MOOC' area with SPOCs (small private online courses). Furthermore, they argue that adaptive learning will be the next MOOC business model to make courses personalized. These new digital platforms and digital systems which are based on digital technologies will finally lead to new and innovative concepts in the teaching and learning but also to digital and data-driven business models within the EdTech sector. In that regard, Prifiti et al. (2017) introduced the term Education-as-a-Service (EaaS) as a business model enabled by cloud computing, which offers a new way to deliver teaching and learning but also to create sustainable business models. Generating any type of digital service with the key resource data and data processes in the background can lead to the creation of a data-driven business model (Hilbig et al. 2018; Exner et al. 2017; Schüritz et al. 2017; Hartmann et al. 2016). The data driven business model is still a very young field of research by itself and becomes more and more relevant in the educational field, too. However, Hilbig et al. (2018) identified three main business model types that are relevant in terms of digitalization and exploitation of data within the EdTech sector, the Low Data Business Model (LDBM), the Data-Enhanced Business Model (DEBM) and the Pure Data-Driven Business Model (PDDBM).

3 Research Design

So far there is a lack of literature on digital, data-driven business models of EdTech companies and how they change the way of teaching and learning within schools, universities or companies. In order to provide new insights on this research subject, in this paper we use a qualitative research approach to explore this new phenomenon (Eisenhardt and Graebner 2007; Yin 2014). The research design is based on two main steps. First, we analysed 313 EdTech companies based in an in-depth qualitative desk research using their

websites, online press articles, social media channels and freely available products to capture innovative teaching and learning approaches and identify their value propositions. Desk research is an important tool of qualitative research and accesses materials that are not primarily collected, and freely available such as online and offline texts, audio formats or videos (Mayring 2010). Our sample of 313 companies was drawn from an exhibitor list of the Learntec 2019[1] which is Europe´s largest digital education event for schools, universities and further education. All 313 companies are from different European countries but mainly located in Germany, Austria and Switzerland.

Second, we used semi-structured interviews to analyse the digital, data-driven business models of 23 EdTech companies from our sample to understand the drivers and barriers of digitization in the EdTech sector. All 23 EdTech companies were interviewed between October 2018 and April 2019. The average duration of the interviews was 1:01h. In total, 10 EdTech Start-ups, 12 EdTech SMEs and one large company were interviewed (2 face-to-face interviews and 21 telephone interviews). 18 companies are operating in the field of further education, four focus on schools and one focuses on university and schools (see appendix 1). Interviews were conducted mainly with the CEOs of the companies. The semi-structured interview guideline focuses on the business model regarding the three main dimensions value proposition, value delivery and value capture (Teece 2010) and to identify teaching and learning drivers and barriers or new approaches through digitalization. The interview guideline consists of the following parts:

- Foundation/Development of the company
- Advantages and disadvantages of digitalization in the educational field
- Value Proposition: focus on digital teaching and learning approaches; establishment of digital or data competences; usage of digital technologies; target market; unique selling point
- Value delivery: focus on key resources in general and data as key resource in specific; aspects and importance of data security, data protection and privacy, data ethics; key processes of the company in general and in regard to data such as data analytics
- Value Capture: revenue and cost-structure
- Business model type: data-driven, data-enhanced, low data

The interviews were randomly transcribed and additional information of the websites, press articles, social media channels or free software accesses, from the first part of the analysis – the desk research has been added to the dataset of each EdTech company. This data was then coded for qualitative content analysis (Mayring 2010). A qualitative explorative research approach is used for the current study. For coding we used an inductive-deductive approach related to main categories of the semi-structured interview guideline. The interview coding was carried out by two researchers and the results reviewed by the third researcher. By using different data sources and three researchers, the dataset was triangulated to increase the reliability of the study (Denzin 1970; Yin 2014). The results of the coding process are presented in two frameworks (see figure 2 and 3). One identifies the drivers and barriers for teaching and learning through digitalization and the other one presents the status quo of how digital data is currently being integrated into the teaching and learning process and which incremental and disruptive innovations are possible with data analytics. Furthermore, the study clusters the business models of 23 EdTech providers into LDBM, DEBM or PDDBM following the work of Hilbig et al. (2018).

[1] https://ausstellerverzeichnis.learntec.de/cgi-bin/kmk_finder_cms/lib/pub/tt.cgi/Ausstellerverzeichnis.html, accessed October 2018.

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3 Results

EdTech providers – Value propositions in digital teaching and learning

With the analysis of EdTech companies, this study changes the perspective compared to current studies. While previous studies focused primarily on the perspective of customers/users (Picciano 2014; Mavroudi et al. 2017; Maseleon et al. 2018), this study focuses on educational providers. The target market of the 313 EdTech providers is clear, 47% are offering educational services to industrial or economic companies in the field of further education, followed by the higher educational and school sector (22%). Figure 1 provides a summary of the different value propositions of the EdTech sample and thus gives a tendency which current digital teaching and learning approaches are offered within the sector[2]. The sample shows that the majority of providers is active in the field of *E-learning (44%)*. Furthermore, new teaching and learning approaches are developed in the area of *Mobile Learning (12%),* which is one of the main trends in the area of digital education (see figure 2). With mobile devices teaching and learning becomes flexible, individual and independent in time and place. This market opportunity is taken by EdTech companies who increasingly provide digital mobile services. In addition to that, EdTech companies are providing digital services in the field of *Infrastructure (8%)* to optimise and digitise communication and administration processes. Lastly, the category *Others* (9%) shows providers who offer products and services which are not educational services at their core. Companies establish themselves within the EdTech sector by providing the corresponding *Hardware (6%)* for digital education at schools, universities or in companies, enabling media-supported digital learning by selling digital whiteboards, tablets or laptops. Further approaches in the sample are in the area of *Blended Learning (5%), Serious Games (5%), Micro-Learning (3%)* and *Virtual Reality/Augmented Reality (2%).* Another important area is *Consulting Services (4%)* for implementation of digital education or the support of digital transformation within companies by means of digital learning and teaching. Only few providers are in the field of classical further education with face-to-face courses (*Offline courses 2%*) or in the redesign of *Online-/Offline Learn Media* (1%). Moreover, there are only two providers in the dataset who explicitly mentioned *Learning Analytics* as a part of their value proposition.

[2] It should be noted that some providers offer a combination of different value propositions such as e-learning combined with mobile learning or offline learning, therefore the evaluation of multiple answers is concerned.

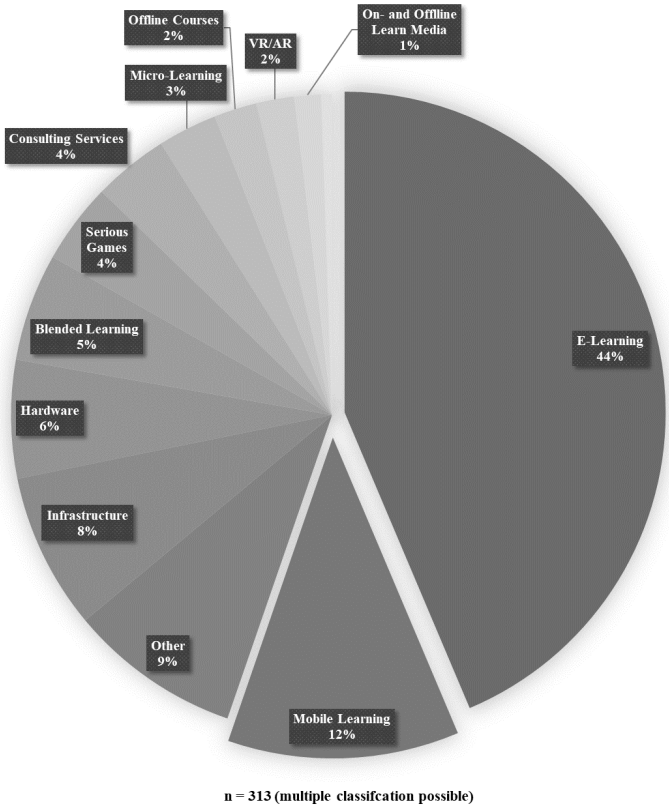

Figure 1 EdTech Providers – Value Propositions in digital teaching and learning

Drivers and Barriers in teaching and learning by digitalization

In principle, it is important to note that teaching and learning are per se subject to different processes of change and adaptation in the course of social developments. In the course of digitalization, however, these changes are now experiencing a previously unknown dynamic. Halim et al. (2011) even go one step further and attest a structure-modifying character of online teaching. A striking characteristic of this new dynamic within the digital society is the increasingly accelerated accumulation of knowledge and experience. Thus, the individual is constantly challenged to actively carry out processes of change and further development in the course of life (Bauman 2003). With reference to the EdTech sector, in the first series of interviews we discovered that the digitally induced dynamics cause various processes of change. The 313 EdTech providers surveyed at the LearnTec are penetrating the market with a broad spectrum of digital approaches (see figure 1). The technical potentials in the EdTech sector already allows a great deal of scope for the design of teaching and learning journeys. However, as can be seen in figure 2, the evaluation of the first 23 interviews with EdTech providers revealed two essential aspects that influence this new development and application dynamics: general cultural change and the individualization of the teaching and learning journey. In addition, sustainability and human contact/socialization are identified as further aspects.

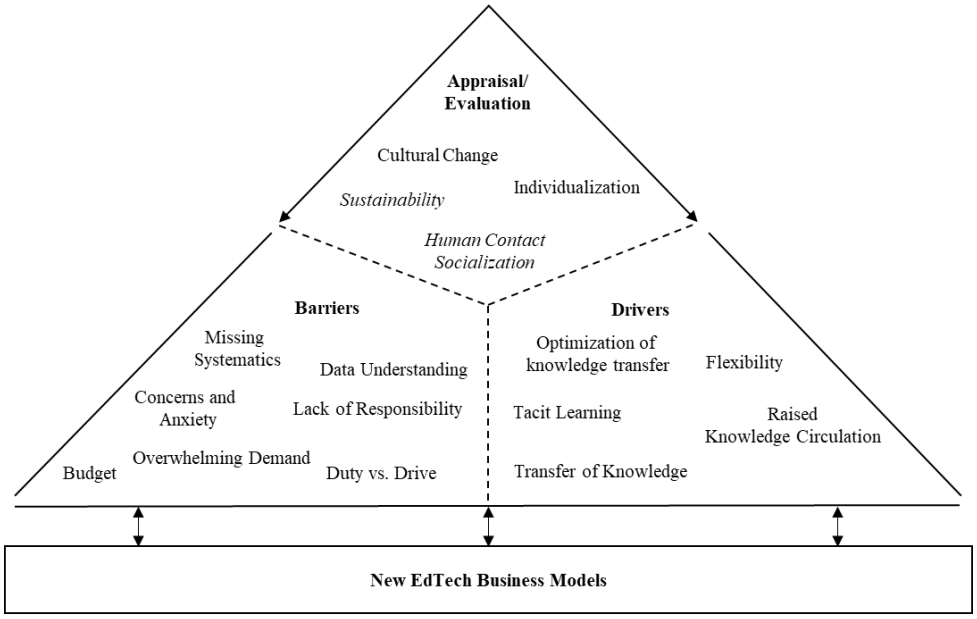

Figure 2 Drivers and Barriers

Regarding the first aspect, it shows that through the use of digital approaches an increased circulation of knowledge can be considered due to the permanent availability of knowledge. In addition, Traxler (2009), among others, state the increasing relevance, sustainable dynamics and identity of mobile learning. This is not least due to the fact that mobile learning enables access for individuals, communities and countries for whom access to knowledge and learning was denied or more difficult. Mobile learning also improves the understanding of learning, enriches and expands per se. This demand for flexible teaching and learning independent of place and time can increasingly be satisfied by EdTech providers. Our results show that 12% of the 313 LearnTec surveyed exhibitors only offer mobile teaching and learning solutions. In addition to this, some interview partners also stated that digital solutions are increasingly in demand and being used to secure the transfer of knowledge by companies. In the context of the increasing shortage of skilled workers in Germany, companies see the use of digital solutions as an opportunity to secure and pass on existing knowledge. However, the general cultural change is accompanied by a lack of a systematic approach. Case 18 comments on this as follows: "*Here and there you offer some key notes with a watering can and some seminars, but the real systematics, that you implant learning into the DNA of the company - I don't see that yet, even with the international companies. So, there are offers, there are further training offers, but it is rather selective further training than a systematic mechanism that people can learn continuously"*[3] (Interview Case 18).

The second main aspect of the teaching and learning journey is formed on the chance to individualize it, i.e. through the collection and evaluation of learning data, the offers can be individually designed and optimized for the learner, the company or the respective department in the company as well as for the teacher. In this way, the needs and potentials of the individual can be addressed in a targeted manner. Following the causality, learning successes and motivation increase. The individualization of teaching and learning opens

[3] The interview quote was translated from German into English.

up highly promising opportunities for innovative business models in the EdTech sector. The first analysis of the 313 EdTech companies shows a clearly defined orientation towards individualization and data-enhanced business models, supported by the 23 in-depth interviews.

Although EdTech providers are aware of this fact, data collection and evaluation have not yet been used for individualization. In this context, authors such as Bond et al. (2018) or Collins and Halverson (2009) already stated that technology as a sole driver of innovation in education is not sufficient. Rather, innovations in curricula, structures, organizations and companies themselves are needed to make the digital revolution in education a reality. In our data the scepticism and concerns of companies, in particular the relevant works councils, are cited as the main barriers. An interviewee in Case 17 notes: *"Yes, I'm very sorry. I have to say honestly, we are always asked somehow: "And, do you analyse?" And it is partly too little, yes. Because we are simply not left to be, but often with fear, because it must be clarified beforehand with the works council, what can be analysed and how and the people in Germany best do not want to talk to the works council at all […] Although it is of course idiotic, because you can also collect the data, so we don't want to go for people, but anonymously collect the data"*[4] (Interview Case 17).

What is striking here is that the EdTech providers can only state a low level of data understanding or sovereignty in dealing with the corresponding data of the decisive instances in the respective companies. This finding coincides with the results of Seyda et al. (2018), who showed that to date companies only use big data analyses to a very limited extent. Out of the 23 EdTech companies surveyed, 12 offer some kind of learning analytics (see figure 3). As a final consequence, EdTech providers only have limited access to data for the further development of their services.

The conflicting relationship between the desire for individualization of the teaching and learning journey and the unwillingness of customers[5] to analyse data can be explained primarily by the lack of data sovereignty. The interviews also cite a lack of technical understanding, fear of control and general ignorance of technical potentials as further significant barriers to the further development of digital teaching and learning formats. In addition, users are often overwhelmed with the technical possibilities and adopt a passive or negative attitude towards digital solutions. One interviewee comment on the following: *"To be honest, we don't work with learning analytics because we have experienced that the data basis is missing and that simply the companies are so far away in terms of maturity and the HR department is still partly working as in the Stone Age. I say that quite clearly. We are simply in reality […] still so far away from these analytics, in the area of human resources, from learning that there is simply no market for them at the moment"*[6] (Interview Case 18). Analogous to this, another interviewee in Case 9 said: *"I was with my colleague a few days ago […] at a common known customer and he said: "Can't I have the tool cheaper if I skip the analysis? […] Well, that's exactly what they said, did they recognize it right or guess it right. The companies are not ready yet. Which is a disadvantage for the companies themselves and for us"*[7] (Interview Case 9). This effect is also reinforced by other instances. Trainers, for example, often regard the use of digital solutions as a threat and not as support. This lack of acceptance also affects the general willingness of digital solutions to be used in teaching and learning, so that the

[4] The interview quote was translated from German into English.

[5] Regarding EdTech providers, the customer relationship follows a so-called 'double customer logic' which means the learner/participant is the direct user of the educational service and actively involved but the client who instructs and pays the service is e.g. a company, a school, an administration institution, a university or the government (Hilbig 2019).

[6] The interview quote was translated from German into English.

[7] The interview quote was translated from German into English.

relevant providers initially have a greater need to educate themselves about the benefits and increasing relevance of digital educational formats.

Furthermore, the interviews indicate that the market does not want a purely digital teaching and learning journey. Rather, people in an increasingly digital society are striving for the human aspect. Digital solutions then serve only partially as substitutes. Schildhauer et al. (2017) advice in a study that combinations of different learning elements, both digital and in familiar teaching situations, meet the needs of the particpants. Particularly in the context of unequal educational opportunities, this factor can create positive change in that education is geared to the learner rather than to the system. The providers have recognized this fact and are already designing their solutions today as a supplement to personal interfaces. Although Seyda et al. (2018) still presents an increasing use of digital learning offers, especially in the provision of literature, learning videos/podcasts/audio modules and interactive web-based learning in the area of further education, the 23 EdTech partners interviewed draw a new picture of the future development of our digital teaching and learning journey. The evaluation of the interviews shows, that EdTech providers already expect a shift towards virtual and augmented reality applications, micro learning, semantic technology, the use of blockchain, bring-your-own-device-solutions, and the increased use of artificial intelligence (AI) in the shape of avatars as digital learning companions. The importance of adaptive, tacit and mobile learning will also increase significantly. Moreover, Trifilova et al. (2016) state in a study that a shift from explicit to tacit knowledge transfer is to be expected, especially in the area of innovation and entrepreneurship. This rapid development once again illustrates the dynamic nature of the EdTech market.

The next step – Innovative learning and teaching with data analytics

The main focus of the business model analysis of the 23 EdTech companies is to analyse how digital data is collected and, by means of data analytics, leads to new, innovative forms of teaching and learning in educational sectors. Following Teece (2010), the business models are analysed with regard to three main dimensions, value proposition, value delivery and value capture, and a focus on the impact of digital data and analytics. In addition, figure 1 presents a broader view on which value propositions are offered by the EdTech providers and in which fields of teaching and learning they are operating. It turns out that seven providers offer e-learning, micro-learning or game-based learning as *Software-as-a-Service (SaaS)* solutions that were developed in-house mainly provided through a Learning Management System (LMS). Furthermore, two companies provide an own SaaS development as open online platform where customers can attend and book online-trainings. Moreover, we introduce a new concept, *Didactis-as-a-Service (DIaaS),* which didactically prepares the content of any form of digital teaching and learning for its customers. The EdTech provider becomes the author and creator of the digital teaching and learning content. Eight providers are offering a SaaS solution combined with DIaaS. In addition, one provider combines DIaaS with organizational consulting for digital transformation while yet another provider only offers educational consulting services. There are three EdTech companies who provide online trainings based on an open or closed platform model. There is just one provider in the sample who offers a self-developed communication tool for different stakeholders in the educational sector. One main research aspect regarding the analysed business models was to understand how the EdTech providers are generate, analyse, process, visualize or distribute data and how digital data effects the teaching and learning process. All providers offer digital educational services which make it possible to measure the teaching and learning behaviour. Figure 3 presents two identified paths of how EdTech providers use data in their business model. The first path delivers the data directly to the client and is not

stored, generated or even analysed by the EdTech provider, we call this *Data Routing.* The generated data of the teaching and learning process is stored on the client's servers and at his responsibility, e.g. case 7 routes the data directly to the client and the client decides what to do with it. The EdTech provider in case 7 has no access rights, therefore the digital teaching and learning process cannot be innovated, improved or optimized by the provider. The second path is determined by the fact that the EdTech provider generates digital teaching and learning data (*Data Generation*) which could be split into personalised user data or non-personalised user data, depending on the regulations of the client and/or the country they are operating in. In a following step, we identified three different levels of *Data Analytics* within the EdTech sector.

1. ***Basic Learning Analytics:*** Collection and analysis of user data such as frequency analysis or mean value. Simple statistics that represent the click behaviour, usage behaviour or media choice of the user, processed as visual graphs, tables or bar charts. This can be compared to the beginnings of e-commerce, where click and purchase behaviour was presented in simple statistical analyses in the early 2000s. Seven providers of the sample are implementing these Basic Learning Analytics as part of their services if the client requests it. Two providers already mentioned Google Analytics as a tool to generate these statistics.
2. ***Learning Analytics + Recommendation****:* Basic Learning Analytics are used and combined with individualized/customized learning recommendations based on the click behaviour, usage behaviour or the media choice. The user receives online and/or offline recommendations of what to learn next and in which order. The EdTech provider analyses the user data and combines it with the digital learning content to improve, customize and innovate the teaching and learning process based on the individual needs of the user. Four providers in the sample already offer these services, e.g. case 19 analyses and observes the learning behaviour of users and offers one-to-one telephone sessions if he/she is not progressing with a learning chapter or task. Case 22 already provides digital recommendations within a closed online learning platform to additional text, audio, video material based on the learning behaviour of the user followed by the Amazon-Logic "Customers who bought this product also bought" adapted to "Users who read this article also read". Using these on- or offline recommendations is an incremental innovation in the teaching and learning process with digitalization.
3. ***Learning Analytics + Adaptive Learning and Teaching:*** Basic Learning Analytics are needed to implement a self-learning system that enables the digital educational service to establish an individual and adaptive learning system based on the teaching and learning behaviour of the user, combined with AI. The digital system itself optimizes and customizes the teaching and learning content without human intervention. It will also revolutionize the teaching process, as the content of lessons will be created automatically using algorithms. This step is going to be the disruptive innovation of teaching and learning through digitalization and a future scenario. Only one provider mentioned a planned project, where they try to individualize and optimize the teaching and learning process in a virtual spacy by means of AI.

To sum up, 12 providers in the sample are already using data analytics as a service within their business model, while 11 providers indicated that learning analytics is currently not part of their business model. Because of that, the sample provides no PDDBM, 20 providers could be classified as DEBMs and three providers even as LDBM.

Furthermore, data as means of payment was neglected by 22 providers, only case 15 mentioned that they already use it following the proposition "*Give me your data and you get a discount"*[8] (Interview Case 15). The future of innovative teaching and learning methods lies in the implementation of learning analytics combined with adaptive learning and self-learning systems in teaching and learning. But the analysis of 23 business models of EdTech providers demonstrates that the market is not ready yet.

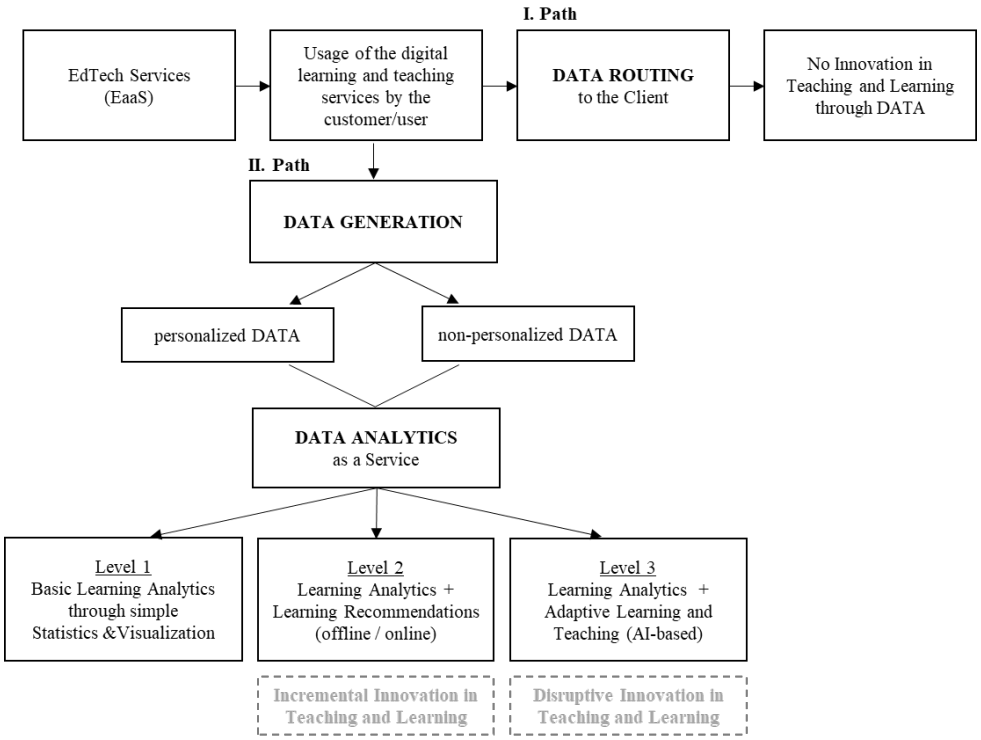

Figure 3 Data Paths and Levels of Data Analytics

4 Conclusion and future Research

Changing the perspective from a user-focus to a provider-focus within this paper, we identified that the differences between the technical possibilities through digitalization and the actual application are still very distinct. Social acceptance and awareness of new teaching and learning formats already exists, but lies still far behind the technical possibilities. The qualitative study pointed out that EdTech providers must invest considerably more time in information processes before the digital applications can be implemented at all. It has also been observed that digital solutions often find their way into teaching and learning processes only in a reduced form. The identified main barriers – a lack of data understanding, concerns/anxiety and missing systematics - are particularly high for the implementation of data analytics. Based on the qualitative investigations, we defined three levels of integrating data analytics within an EdTech business model: *Basic Learning Analytics; Learning Analytics + Recommendation; Learning Analytics + Adaptive Teaching and Learning*. The application of these levels

[8] The interview quote was translated from German into English.

are implemented by 12 providers of our sample but mainly through *Basic Learning Analytics* or *Learning Analytics + Recommendation.* The proclaimed disruptive innovation through *Learning Analytics + Adaptive Teaching and Learning* seems more a future scenario then a possible reality by now. Although the individualization of teaching and learning processes offers numerous opportunities in terms of efficiency and effectiveness, both EdTech providers and EdTech users remain sceptical. In addition to legal restrictions, it is above all the individual himself who strives for self-determined and human interaction in his own teaching and learning journey. With this finding, our study again distinguishes itself and supports previous study by Huda et al. (2016) and Seyda (2018). Digitization can only offer sustainable added value for the education and training sector where opportunity and reality enter into dialogue and develop a common understanding of future steps. Not the providers, but the customers/users currently setting the dynamics within the EdTech sector. Whether this trend will change, cannot be deduced from our first study. This will certainly require further in-depth studies.

In addition, our results show that the current business models of EdTech providers are far less data-driven than intuitively assumed. However, the analysed sample demonstrates only DEBM or LDBMs with the EdTech sector. Interesting is the fact that the providers do not assign data any or only little relevance as a means of payment. Therefore, it can be assumed that there is a bigger gap and potential in the processes of innovation in education and training in the context of digital transformation, especially in comparison with other industries. Both research questions could be answered by means of the qualitative research design and the literature analysis. The limitations of the study are due to the fact that from the 313 EdTech providers only 23 providers have been interviewed, in order to give further directions and recommendations, more interview partners and case studies are needed. Nevertheless, this research field is still at the beginning and further studies regarding the implementation of data analytics within schools, universities and companies are needed to understand how digitalization changes our educational systems and our teaching and learning processes. From a meta-level perspective, this study provides first insights of future developments in the EdTech sector (see figure 2 and 3) and presents the current state of the art on EdTech providers. Finally, it remains to be seen which digital applications will actually be used in our future teaching and learning journey on a long-term and sustainable basis.

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Appendix

Appendix 1 This is the title of my table and it goes above my table

Company		*Educational Sector*	*Interview Date*	*Interview Duraction*	*Interview Type*	*Position of the Interviewee*	*Number of interviewers*
1	Start-up	Further education	14.03.2019	0:57	Telephone	CEO	1
2	SME	Further education	22.03.2019	1:00	Telephone	Head of Business Development	1
3	Start-up	Secondary Schools	21.03.2019	1:03	Telephone	Founder & Web Development Consultant	1
4	SME	Further education	20.03.2019	1:21	Telephone	CEO	1
5	Start-up	Schools, Kindergarten	14.03.2019	0:47	Telephone	Sales Manager	1
6	SME	University, School	29.03.2019	1:06	Telephone	CEO & Founder	1
7	Start-up	Further education	22.03.2019	1:15	Telephone	CEO	1
8	SME	Further education	11.03.2019	0:58	Telephone	CEO & Co-Founder	1
9	SME	Further education	29.03.2019	0:53	Telephone	Director of International Marketing	1
10	Start-up	Further education / Aprenticeship	20.03.2019	0:55	Telephone	CEO	1
11	SME	Further education	22.03.2019	0:55	Telephone	CEO	1
12	Large Enterprises	Further education	22.03.2019	1:23	Telephone	Virtual Trainer	1
13	Start-up	Further education	03.04.2019	0:33	Telephone	Co-Founder	1
14	Start-up	Further education, Universities, NGOs	03.04.2019	1:41	Face-to-Face	Project Manager	1
15	SME	Further education	04.04.2019	0:56	Face-to-Face	CEO & Founder	1
16	Start-up	Further education	01.04.2019	0:56	Telephone	CEO & Co-Founder	1
17	SME	Further education	04.05.2019	0:53	Telephone	CEO & Founder	1
18	Start-up	Further education	03.04.2019	0:38	Telephone	CEO & Co-Founder	1
19	Start-up	Further education	17.10.2018	1:15	Telephone	Marketing & Sales Manager	2
20	SME	Schools	21.12.2018	1:22	Telephone	CEO	1
21	SME	Further education	18.02.2019	1:14	Telephone	Project & Marketing Manager	1
22	SME	Schools, Secondary Schools	08.02.2019	0:47	Telephone	CEO & Founder	1
23	SME	Further education	07.03.2019	0:55	Telephone	CEO	1

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