Mobile e-Learning App Economy

Philipp Rockahr, Joachim Griesbaum, and Thomas Mandl

Abstract—**This paper provides a tentative overview and first approximation of the growing e-learning app economy and delivers first insights of its impact on learning with a focus on primary education. For that purpose, a tripartite explorative research design was employed, consisting of: a) a market overview with a focus on business models and providers, b) an expert-based assessment of the learning and interface design of a sample of learning apps, c) an oral survey of teachers and pupils to understand and express their appraisal of learning apps. Results show that in the mobile app economy there is a larger variety of vendors than in the classical e-learning market. Most of the investigated apps do not follow sophisticated didactical paradigms, but employ a drill and practice approach and exhibit simple and usable interfaces. Teachers assess learning apps primarily as suitable tools to complement traditional teaching. Pupils' assessments indicate that game-based elements, especially with rewards, are in high demand as they raise and maintain the motivation of the learners.**

Index Terms—**Mobile learning, app economy, primary education.**

I. INTRODUCTION

In a time when smartphones are nearly ubiquitously used, the significance of these devices and corresponding applications (apps) is on the rise. Although, there are manifold research studies on mobile learning [1], there is still no widely acknowledged common ground for mobile learning in real-life teaching. This is not surprising, because in many countries teachers' computer literacy and computer usage in schools are rather mediocre [2]. Against this background, this contribution aims to enhance our understanding of the growing mobile E-Learning app economy. It aims to provide first insights about its impact for learning with a focus on primary education. For that purpose, an explorative research design, consisting of three components, was applied: a) firstly, the app market was analysed – the focus of analysis was on business models and providers; b) furthermore, a small sample of learning apps was evaluated, concerning inherent learning and user interface design; c) finally, the teachers' and pupils' estimation of learning apps was captured through interviews. For pragmatic reasons, the study's area of investigation is restricted to one specific market – the German app market. In addition, the domain is also limited to primary education. Nevertheless, the approach and the results of the study should be relevant to anyone interested in the emerging mobile E-Learning app economy and its impact on education.

The paper is divided into the three research components. These are presented in the aforementioned sequence: a to c. The paper closes with a discussion of the results of the investigation and an assessment of its methodological approach.

II. THE MOBILE E-LEARNING APP MARKET

The establishment of the Apple App Store in 2008 marked the formation of an app economy. According to [3], "the rapid development of mobile apps for mobile devices is taking the educational world by storm". Pursuant to a recent expert survey, mobile learning will be the primary driver for revenue in e-learning and, seen from a commercial perspective, mobile learning apps are estimated to be the most successful type of learning tools [4]. Thus, the significance of the educational app economy is evident. It is important to note that the mobile e-learning app market is not just a mirror or a continuation of the e-learning market, but has specific properties with regard to providers and business models. First of all, there has been an expansion of the types of providers who are active in the market. In traditional or stationary e-learning, we have mainly observed three kinds of providers: e-learning producers (such as IT companies, advertising agencies, etc.), academies, colleges, universities, specific distance education vendors, and publishers; e.g., educational publishers. In the mobile e-learning app market, we have additionally monitored telecommunications providers, games manufacturers, and even one-person companies or private individuals [5]. Fig. 1 shows the old and new providers in the mobile e-learning app market.
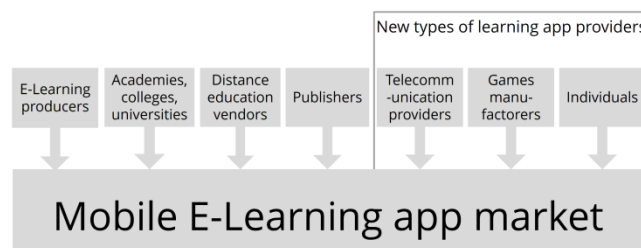

Fig. 1. Providers in the mobile e-learning app market.

In addition, the mobile e-learning app economy exhibits peculiarities with regard to distribution and revenue models, as well as different learning arrangements. Whereas traditional e-learning is usually distributed and supplied either directly from the producer or a multitude of educational institutions or platforms, mobile learning apps are available as off-the-shelf-products in the popular app stores (Google, Apple, Amazon, Windows) [5]. Revenues are generated either through advertisements (in-app-advertisements) or (in-)app purchases. Furthermore, three different types of learning arrangements can be

identified: 'solitary apps' which are not connected with further services and can be used independently; 'embedded apps' which are connected with further services usually provided on a web server; and 'embedded social apps' which expand existing stationary learning arrangements with mobile device usage.

To gather additional insights with regard to the mobile e-learning app market, this investigation captures the view of app providers with regard to learning arrangements, revenue models, and future trends. For that purpose, guided phone interviews were prepared. Guided interviews are partly structured, which alleviates the need for comparison of individual interviews. At the same time, such interviews are flexible enough to include additional topics or statements yielded situationally in the individual interviews. In addition, it seemed important that the sample should take the diversity of providers (cp. Fig. 1) into account and also include companies of different sizes. Therefore, a sample of 25 providers in the categories 'education' in the Google Play Store and Apple App Store were pre-selected and contacted by mail. Five providers agreed to participate in a phone interview. All participants resemble a different type of provider. In addition to an individual provider and a scientific foundation, the sample consisted of a computer game manufacturer, a school book publisher, and a multimedia publisher. All interviews were transcribed and summarized according to [6]. The results of the interviews are delineated below.

A. Learning Arrangements

The learning arrangements of the learning apps of the interviewed providers encompass a wide span of possible usage contexts. The vendors offer 'solitary apps' which can be used as a stand-alone learning tool, 'embedded apps' that serve as an expansion of other digital learning services, as well as 'socially embedded apps' connected with stationary learning. The last type – socially embedded apps – were provided only by the school book publisher, a 'big player' in the sample. These apps are related to school books and offer additional exercises. Moreover, this vendor also offers solitary apps that are focused on and related to the official school curriculum. In another interview, 'after school content' was mentioned. This indicates that apps can be differentiated with regard to their primary usage focus, be it in class or after school. Interestingly, all participants denied that there are already established technological or content-based standards of learning apps. Nevertheless, the interviewees assessed a certain recognition value of their app portfolio as an important success factor in the achievement of repeat purchases. As a whole, a high-quality of the content provided within an app was seen as the most important factor for acceptance on the part of pupils and the parents. There was no clear picture amongst the participants if the content should explicitly relate to the school curriculum. It was estimated that a fun component is important in order to initiate and sustain motivation on the part of the learners.

B. Revenue Models and Marketing

With regard to revenue models, the interviews show a clear picture. With the exception of one provider that does not aim to make a profit, all organisations offer fee-based full versions of their learning apps. Only one also offered a lite version, upgradeable via an in-app purchase. In addition, this provider also offered volume purchase programs for schools. The majority of the interviewees stated that in-app purchases and lite versions have a bad image and are not well accepted by parents and pupils. Customers would rather use complete and comprehensive products and they consider later expansions of the apps (functionality) to be annoying. Schools try to calculate a predictable budget that covers all costs before the app is acquired. Moreover, none of the interviewed app providers employs in-app advertising. One interviewee said that especially parents of young children reject such advertising, because it may direct the children towards uncontrollable acts. With regard to marketing, there is no special focus on app store optimization. Instead, the participants often mentioned cross marketing strategies using other products or platforms (school books, games) to advertise their learning app(s). Another strategy mentioned was to promote the learning apps on public educational platforms – e.g., the German education server (eduserver.de) – that are often used by teachers and other professionals as gateways to find education-related content.

C. Future Trends

According to the participants' estimation, the future of the mobile e-learning app economy has a bright outlook. Following the diffusion of mobile devices in learning contexts, learning app usage is estimated to further spread and grow. Nevertheless, learning apps are not seen as a means to all possible educational ends. The school book publisher in particular stated that mobile learning apps are limited to specific educational areas and contexts. The educational value of learning apps is seen in their ability to provide small and limited content units or exercises that supplement or accompany in-class learning. The (visual) illustration of problems or concepts and the possibility of conducting exercises (individually and repeatedly) are seen as areas in which learning apps could excel. Furthermore, there is also a feeling that Germany falls behind in relation to other European countries, because the technical infrastructure in schools is lacking and many stakeholders (teachers, parents) are assessed as being rather sceptical of game-based learning approaches.

In sum, this short introduction into the mobile e-learning app market generates some interesting insights. First, in comparison with the 'traditional' e-learning market, we see that there is an expansion of the types of actors on the supplier side. Secondly, with regard to learning arrangements, we note that apps can be used independently, but could and should usually be an integrated part of a wider learning environment. Although there are no observable established technological or content-related standards, apps often seem to relate to game-based learning approaches. The stakeholders seem to prefer direct monetization models.

In contrast with the content economy of the World Wide Web, advertising-based revenue models seem not to be well accepted. Finally, although it seems that the future of learning apps has just begun, at present they are only considered valuable in a limited and rather narrow educational context.

III. Learning App Evaluation: Learning and User Interface Design

To provide an exploratory in-depth look into the design of learning apps, the learning related design and interface of a small sample of apps was inspected by an expert. The category 'education' in the Google Play Store and Apple App Store and the respective app store search functions were used to detect and select apps for further investigation. In order to choose a sample of apps that are basically comparable, it was decided to focus on apps that are geared towards primary education and that could also be used outside of the classroom (e.g., after school; cp. Section II). Moreover, the most important subjects should be covered equally. Therefore, it was decided to pre-select 10 apps (preferably five from each store) for each of the subjects German, Mathematics, Local Geography/History/Biology, and English/Languages from the top charts in the app stores. Each of the apps was assigned a random number and a random sample of five out of the 10 apps per category was chosen as the sample for further analysis. The distribution of apps between the two stores was arbitrary. Many apps offer versions for both operating systems (Android and iOS). The following table shows the analysed apps.

TABLE I: Analysed Apps (*Local Geography/history/Biology)

Name	Subject	System	Price (Euro)
Grundschule Sachkunde Klasse 1-4	LG/H/B*	Android	3.78
SachMeister	LG/H/B*	Android	3.57
Explorium-Ozean für Kinder	LG/H/B*	iOS	2.99
AMA Apfel Lernspiele	LG/H/B*	iOS	free
GEO Mini Ozeane	LG/H/B*	iOS	3.99
Grundschule 2. Klasse plus Rechnen	Maths	Android	0.99
Rechnen lernen mit Quintus	Maths	iOS	1.99
Rechenmeister	Maths	Android	free
Blitzrechnen 4. Klasse	Maths	Android	0.99
Conni Mathe-Spiele 1. Klasse	Maths	Android	3.99
Bausteine-Deutsch Klasse 1	German	Android	2.99
Appolino Lesen	German	iOS	2.99
Buchstaben Post	German	iOS	free
Lernspiele 1. Klasse	German	iOS	0.99
Olche ABC-Buchstabensuppe	German	Android	3.99
High5-Englisch für Kinder	English	Android	free
Ernie the Owl	English	iOS	2.99
Squirrel & Bär	English	Android	4.99
Kinder lernen Englisch	English	Android	free
Janosch ABC-Englisch lernen	English	iOS	1.99

A. App Evaluation Design

We have already introduced the learning arrangement concept for learning design in Section II. With regard to the instructional role of apps, we related this to the classification of constructive, manipulative, and instructive apps as proposed by [7], which was applied and refined by [8] for mathematics education. Thus, we used the following categories: simulation, tutorial, drill and practice, guided discovery, composing, and informative. Furthermore, we wanted to determine if the analysed apps are explicitly aligned with the school curriculum. Interface design is a success factor of learning apps, because it helps in learning and understanding the system and determines the cognitive load of the learner [9]. In order to analyse the interface design, we chose fitting interaction design criteria from the comprehensive set, as discussed in the literature. We selected six user interface design criteria according to [10]: clarity, compatibility, comprehensibility, configurability, consistency, and efficiency. These criteria were supplemented with 'engaging interaction/ immersion', 'minimal cognitive load', and 'increased feel factor' from [11] to capture the user experience of the analysed apps. The fulfilment grade of the above interface design criteria was measured using a four-stage ordinal scale, including the grades 'completely fulfilled', 'largely fulfilled', 'partly fulfilled', and 'not fulfilled'. Finally, to complete the analysis of the interface design, the integration of gesture controls (tap, double tap, swipe, drag, pinch, or spread) was observed.

B. App Evaluation Results

The analysis was executed by the first author of this paper in September 2016. All apps were downloaded and tested either on an LG G4 (Android) or iPhone 4s (iOS) smartphone. Half of the providers were typical e-learning producers or software companies. Additionally, five publishers – of which three were school book publishers – were represented. We also included private persons, a games manufacturer, and a political education institution among the providers. The revenue models mirrored the argumentation in Section II (cp. Table I). Most of the apps charged a small fee; a minority were free. Just four providers used in-app purchasing and of those four only two employed in-app advertising. None of the fee-based apps relied on advertising or in-app purchases.

With regard to learning arrangement, the large majority of the sample can be categorized as 'solitary apps'. Three apps are 'socially embedded apps', which either relate to school textbooks or exercise books. Only a minority of the apps (6) show a direct relationship with the school curriculum. With regard to their instructional role, the large majority of apps realizes an instructive design often embedded in a game-based environment as illustrated in Fig. 2.

Fig. 2. App screenshot of Conni Mathe-Spiele 1. Klasse.

In the app in Fig. 2, pupils have to accomplish basic arithmetic operations (addition, subtraction, multiplication, and division) and they play games to reach this goal. Here, the user has to determine the factors of the number eight with the help of a canon that needs to be loaded with the right factor which, added to the number one, equals eight.

Fig. 3 shows the distribution of the detected instructional categories in the sample of the investigated apps.
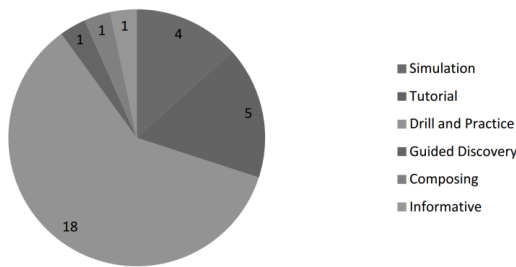
Fig. 3. Instructional categories.

As can be seen, all of the instructional categories are present in the sample. The predominant instructional role of the apps is drill and practice. In addition, simulation and tutorials are also common. A large fraction of apps includes more than one instructional category.

In relation to the interface design, table gives an overview of the expert's assessments of all apps.

TABLE II: ASSESSMENT OF INTERFACE DESIGN IN PERCENT OF ALL APPS

Criterion	Completely fulfilled	Largely fulfilled	Partly fulfilled	Not fulfilled
Clarity	60%	30%	10%	0%
Compatibility	85%	0%	10%	5%
Comprehensibility	60%	25%	15%	0%
Configurability	30%	20%	10%	40%
Consistency	95%	5%	0%	0%
Efficiency	70%	15%	10%	5%
Engaging interaction/ immersion	45%	30%	20%	5%
Minimal cognitive load	75%	10%	10%	5%
Increased feel factor	60%	20%	15%	5%

With regard to app control, every app used taps, drags were used in 13 apps (65%), and swipes in seven apps (35%). There was no usage of double tap or pinch and spread gestures.

In sum, the app evaluation widely corresponds to the market and the provider-based view as described in Section II. Regarding learning design, the sample indicates that there is a focus on instructive didactic designs, predominantly employing drill and practice (exercises on basic arithmetic operations or vocabulary) or knowledge-transmitting simulations and tutorials explaining basic concepts (often in apps relating to the subject Local Geography/History/Biology). Therefore, these apps can be estimated to be rather simple additions to existing learning designs and scenarios, and not as diverse and comprehensive alternatives or even substitutions. However, simple does not mean bad. With regard to user interface design, the analysis shows a very positive picture. Most of the apps correspond to a high standard in human computer interaction design. They are consistent and comprehensible. Still, there is room to offer users more configuration and personalization options. The user experience is predominantly good, although only roughly half of the apps provide a really immersive learning experience and are, therefore, motivating in the long-term. This partly corresponds with the drill and practice concept of many apps with monotonously recurring exercises. Thus, the joy of use is often limited over time. App controls are very

simple. The omission of certain double gesture controls contributes to the simplicity of the interaction.

IV. TEACHERS' AND PUPILS' ASSESSMENT OF LEARNING APPS

The perception of the primary target groups – teachers and pupils – were captured in the interviews. The participants were recruited via an email that was sent to five primary schools. Two schools responded positively. From these two schools, six teachers and 17 pupils were recruited in total. For the investigation, guided interviews with teachers (between 28 and 46 years old) and focused interviews with pairs or triads of pupils (third and fourth graders) were prepared. With regard to the teachers as the primary gatekeepers of school-based learning, we were interested in their attitude towards learning apps and their assessment of instructional designs (design criteria). Participants should describe their assessment of a) the mobile learning trend as a whole, b) the didactic context and instructional design of learning apps, and c) their experience with learning apps. In relation to the pupils' perspective on the topic, the research focus was on their opinion of the interaction design. Additionally, the aim was to obtain insights into their app usage and app usage motivation. At the start of the interviews, the pupils were guided through a selected learn app (Squirrel & Bär, cp. Table I) to provide them with a vivid example (and therefore context) of a learning app before any questions were asked. All interviews were executed between September 19 and 23, 2016, and took place in a separate room in each of the two schools. All interviews were transcribed and summarized according to [6].

The results with regard to the pupils' perspectives are as follows. All of the interviewed children use mobile devices regularly and 10 of them also said that they have already used a mobile learning app. App usage is typically frequent (several times a week), but rather short term: "only two or three days, then I like to play different games". The other pupils – the 'non-users' – said that they could envisage using learning apps. This indicates a positive attitude towards mobile learning apps. Most pupils stated that app usage is self-propelled. Three of the pupils answered that their parents initiated app usage. In both cases, the basic motivation was to become better in the respective subject that was addressed by the app. With regard to interaction and interface design, the children emphasized that rewards are important for their motivation. Here, the children explicitly mentioned fictitious money, puzzle pieces, additional calculus modes, new levels, higher difficulty grades, and new characters. The children were attracted to and enthusiastic about the playful elements of the selected learning app.

The teachers assessed mobile learning apps as a long-term trend and a chance to use the attraction to pupils of mobile devices to facilitate their willingness to learn. With regard to the didactic context and instructional design of learning apps, there was a variety of perspectives and arguments. First, it was argued that mobile learning apps could not be seen as stand-alone offers. The value of learning apps must be considered in conjunction with existing learning approaches, especially as children in primary education are not yet able to

reflect on their learning behaviour. Another participant emphasized that mobile learning apps foster autonomous learning and also increase technical understanding. With regard to instructional design, the possibility to adapt learning to a pupil's prior knowledge and abilities was seen as a possible strength of such apps. Nevertheless, it was consistently stated that the instructional design should always relate to the specificities of the subject and the learning style of the user. Against this background, learning apps are seen as suitable tools to consolidate knowledge. Thus, the predominant drill and practice approach, as detected in the app evaluation in Section III, fits well with this behaviouristic categorization of the participants. Asked about their own experience with apps, half of the teachers said that they actively suggested supplementary learning app usage to pupils to compensate for dyscalculia or other weaknesses.

V. DISCUSSION

As a whole, the three investigated perspectives of the mobile E-Learning app economy deliver some interesting insights. The overview of the market shows that the mobile dimension changes the learning market itself. The app stores are now the primary access channels. They concentrate distribution, thus facilitating immediate app access. On the other hand, the educational areas in the stores are structured poorly. Therefore, it can be difficult for the user to find the right app. In this regard, the current marketing approach of app providers to employ other channels to advertise such apps seems to be adequate. Furthermore, we discovered an expansion on the side of the app suppliers. We found provider types that are already established in education and/or the E-Learning market and we also detected new players (individuals and game manufacturers). This may be due to the attractiveness of game-based learning or lower transaction costs for app provision and distribution (in the app markets) that may be attractive to specific 'producer segments'. At the same time, we found that although revenue models are primarily fee-based, lucrative business deals or large profits are seldom or unlikely, because the cost per learning app is usually rather low; in our sample, it ranged from 0.99–4.99 Euro. Therefore, the mobile E-Learning app economy resembles a kind of large quantity, small price per unit, market.

The app analysis reveals that in most cases learning apps include a drill and practice approach that is often enriched by either a simulation or tutorial component, depending on the subject addressed by the app. There is a clear focus on rather simple, instructive, didactic designs. Nevertheless, simple does not mean bad. The analysis shows that the user interface design usually corresponds to a high standard of human computer interaction design. The investigated apps are consistent and comprehensible. In sum, the apps are simple but well made. They should be seen and treated as supplements to existing learning designs. An overuse of such learning apps in formal education could be considered to be a threat, as argued by [12] in a web article entitled Four Reasons to Worry About 'Personalized Learning'. In this article, the author fears that the diffusion of mobile learning apps leads to a revival of old-fashioned instructional

practices and possibly also to a tendency to 'dehumanize learning'. However, such fears seem to be unfounded. The interviews indicate that the apps take the 'correct place' in education. Both interviewed groups – teachers and pupils – esteem them to be a worthwhile supplement in learning and do not consider them indispensable basic tools. Teachers value their motivational effects on learning, the mediation of technical competence, and the possibility to compensate for weaknesses in basic skills such as calculation. Pupils use them to become better and are easily motivated by the apps' inherit playful elements and corresponding extrinsic rewards. As a whole, the interviews indicate that the target groups are ready for and capable of adapting mobile learning apps. Seen from the users' perspective, the mobile e-learning app economy can be estimated to be a sustainable trend, which has the potential to improve learning.

With regard to the methodological perspective, this paper should be assessed as explorative. The empirical study uses small samples. In addition, all considerations are related or restricted to the German app market, which probably differs in many ways from other markets. For that reason, results cannot be transmitted to other markets or generalized that easily. Nevertheless, this paper makes two important contributions. First, it provides a new and holistic view of mobile E-Learning apps. It triangulates the views of app providers with an expert analysis of apps and also captures the perspectives of gatekeepers and users. Second, it provides a multi-layered picture of the educational impact of this kind of app-based technological innovation in education.

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