The use of digital reading pens in the early foreign language classroom

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In order to actively participate in a globalised and digitalised world, students must develop a wide range of competencies from a very early age onwards, among them, communicative competencies in the English language and digital skills. To this end, technology has become a strong ally for teachers, utilizing the strengths of smartboards and the like. Yet, the digital infrastructure in German schools is rather limited. Thus, digital reading pens have become popular, as their use does not require internet access. Whether those pens add any value to formal language learning processes, however, is a question TEFL research has just started to find an answer to. The study in this paper aims to discover the benefits of digital reading pens in a primary foreign language classroom in Germany. Two separate studies were conducted; the first focused on reading aloud competencies and the second focused on English vocabulary, pronunciation and spelling. Both study samples consisted of 3rd grade primary students, who were divided into a control group that worked with the teacher and an experimental group that worked with the reading pen. In both studies, both groups showed an increase in all aforementioned variables, regardless of the source of input, i.e. language model, they used.

Key words: Digital Reading Pen, EFL, Primary School, Language Learning

1. Learning and Teaching English in German Primary Schools

Foreign language instruction in German primary schools is compulsory from 3rd grade onwards. On average students are offered two hours of English[1] per week. The goal is to develop English language competencies at the A1 level of the CEFR by the end of grade four. Teaching and learning follow a holistic approach with a clear focus on oral skills' training. Games, songs, rhymes and dialogues are frequently used to build vocabulary, and train students´ listening and speaking competencies (Elsner, 2015). Reading and writing play a minor role in the early foreign language classroom, yet children read and copy the vocabulary they are supposed to actively use in conversations; moreover, they

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[1] Some schools located near the French boarder offer French as the first foreign language, yet English is the norm.

read simple sentences and short texts with the support of the teacher. Teachers´ main task is to motivate students to speak the foreign language as often as possible, enable comprehension through interactive learner support (scaffolding) (Gibbons, 2002) and provide the students with various resources for encountering and practicing new words to build up and retain vocabulary (Elsner, 2015). To enable children to connect English phonemes and graphemes as well as to prevent wrong pronunciation, it is recommended to let children repeat new vocabulary and read aloud words and short sentences often and repeatedly and in varying contexts (Keaveney & Lundberg, 2014). However, since the amount of teaching lessons for English as FL in primary school is usually limited to two or three hours per week, it is difficult to reach all learning objectives within instruction time. Therefore, additional opportunities for autonomous learning should be provided for the learners. As learners usually do not learn voluntarily at home if learning materials are too "schoolish" (Smith & Wilhelm, 2004, p. 460), the provided tools and activities should be motivating and fun.

In this context multimodal and technology based interactive materials come into play, as they not only appeal strongly to children but may also serve as powerful instruments to spark learning processes, given the fact that they are chosen wisely and integrated adequately into the teaching and learning procedure (National Association for the Education of Young Children, 2012).

Research looking at the use of digital technologies in language classrooms shows that learners of all levels can benefit from their use with regard to language development, as they offer the opportunity to involve more students actively in the learning process at a time (Derakshan et al., 2015). Cutrim-Schmidt (2018) demonstrates such learner-activating and motivating effects when using smartboards in primary school English lessons for a tele-collaboration project. Other studies show that learners cooperate more intensively with each other when using digital devices such as tablets to produce stories in the foreign language classroom (Dausend, 2018). Bernert-Rehaber and Schlemminger (2013) promote the potential of virtual learning worlds and serious games for language learning, since these, according to the authors, initiate action-oriented, self-directed and discovery-based learning situations. Moreover, the use of digital technologies in the language classroom offers opportunities for more individualized development and differentiated support, e.g., through adaptation and feedback (Heinen & Kerres, 2015), e.g., in vocabulary learning, grammar or reading apps, or in multilingual resources for language learning such as multilingual digitalized storybooks (Buendgens-Kosten & Elsner, 2018).

Despite of these results, the systematic use of digital technologies in classrooms has not yet become commonplace (Drossel et al., 2018). Although teachers consider themselves to be generally open-minded with regard to the use of technology in their classrooms (Bitkom, 2015), less than one third of all teachers in Germany regularly make use of them (European Commission, 2014; Drossel et al., 2018). On the one hand, this is due to the fact that teachers themselves are still rather skeptical about the added value of digital technologies with regard to competence development of learners (Schwanenberg et al., 2018). On the other hand, teachers lack (subject-related) digital competencies and corresponding planning competencies for the digitized lesson design and, even more fatal, most German schools still lack a sufficient digitized infrastructure (WDR, 2019). Especially teachers in primary schools complain about scanty circumstances: no access to the internet, a lack of tablets and/ or interactive boards, and no centralized IT support.

Against this background, "easy to handle" media such as paper-based textbooks and CDs or digital technologies that work without Wi-Fi and complicated installation procedures, such as the digital reading pen, are preferred by the teachers (Priboschek, 2017).

2. Digital Reading Pens in the Early Foreign Language Classroom

Digital reading pens (also called digital audio pens) have become quite popular in Germany (and in other parts of the world) on a private basis as well as in school contexts (Rechlitz & Lampert, 2010). The digital pens (such as TINGsmart, TipToi, Bookii or the Anybookreader) work in combination with books, including textbooks (for the EFL classroom). By placing the reading pen on a picture, symbol or word in the book, previously recorded audio-files (either words or sentences, spoken by a native speaker) are played from a speaker integrated in the reading pen. Children can use headphones to work on their own or use the loud-speaker function of the pen to work in pairs or a group.

Research studies on the use of digital pens in the context of first language literacy development show a wide acceptance for reading pens as a useful and motivating toy by children and parents (Rechlitz, 2017). Droll and Staiger (2015) evaluated students' usage of reading pens in combination with books during first reading clubs in multiple primary schools in Freiburg, Germany. The results show that, since the books have a low threshold for engagement, students tend to spend more time with them during their free reading time as compared to the time they spend with looking at paper books. The authors assume that since the digital tools are primarily designed as entertainment, they are simply more motivating to children. Yet, they argue that reading pens cannot be seen as a replacement for a teacher or caregiver, but they can be a stepping-stone into a culture of reading and writing.

Chen, Chen and Chen (2015) found that Taiwanese children, reading digital pen supported paper picture books in English, show higher reading motivation and better comprehension of the book than children reading paper picture books or electronic picture books. Rothstein (2017) points out, that digital pens used in family or in kindergarten contexts build first literacy experience. However, they cannot and should not replace human interaction when reading aloud. Nevertheless, they can serve as an additional tool to support literacy development.

In the context of foreign language instruction in primary classrooms in Germany, reading pens have been discussed as a suitable supportive tool for adaptive learning processes, especially with regard to vocabulary learning and pronunciation practice as well as in terms of reading aloud practice (Glaser, 2018; Rymarczyk, 2014). The combination of sound, images and typeface provided by the reading pens and the corresponding texts, offers learners a multimodal resource for working with words. Moreover, learners can listen to the words and sentences as often as they need to from an individual point of view. The "time on task hypothesis" suggests that the amount of time spent with a task (i.e., hearing, reading and using vocabulary) has an important impact on the learning outcome (Carroll, 1973; Hopf, 2005). Yet, content needs to be practiced in various ways and in different contexts (Larsen-Freeman, 2012), and reading pens provide varied iteration.

Glaser (2018) concludes that reading pens have many advantages: method and material variety, learner-centeredness, increase of motivation, options for differentiation, and most importantly, a continuous provision of meaning, spelling and articulation. Simultaneous presentation of spelling and articulation, moreover, helps alleviate any problems related to phoneme-grapheme correspondence. Yet, Glaser also points to the limitations of the product: spontaneous, unplanned discursive speech is still in need of a real collocutor and cannot be replaced by a digital pen, not even if it has a recording function, like many of the newer versions do.

Research on the use of reading pens in foreign language classrooms in primary school and their impact on the development of certain competencies, however, is still scarce.

3. Research questions and hypotheses

On the one hand, empirical studies show positive effects of digital learning tools on motivation and language proficiency in language classrooms; on the other hand, it is argued that those tools cannot replace the teacher as a language model. However, with regard to digital reading pens, it can also be argued that –within a limited scope, for example with regard to pronunciation, vocabulary learning or practicing reading and speaking aloud – teachers, as well as reading pens, provide an authentic language model to the students (in case of the reading pen even an audio file of a native speaker). Furthermore, time with the teacher as language model is very limited during classroom time, especially when students work individually on different learning tasks, and not available when practicing at home. Therefore, the following overall research questions were formulated:

1. Does the use of digital reading pens for vocabulary learning (in terms of meaning and pronunciation) and reading aloud practice lead to the same learning effects as the rather common "teacher-as-input-provider"/ "language model" approach in EFL instruction in primary school?
2. Are reading pens suitable to providing additional study opportunities and motivate autonomous learning for primary school children learning EFL?

Therefore, two different exploratory studies were conducted, both using a quasi-experimental pre-post-cross-sectional design, and both comparing two groups of German 3rd-grade primary school children, either with a reading pen or a teacher as language model for practicing reading and pronunciation in English (EFL). Both studies are going to be described below.

3.1. Study 1

The first study focused on the effect of reading pens on reading aloud competencies of children, consisting of reading fluency (operationalized by WCPM-score (e.g. Hasbrouk & Tindal, 2006): amount of words read in 60sec – amount of errors) and pronunciation of target words, as well as reading motivation (frequency of reading at home) as dependent variables. The source of input (i.e., the language model) served as independent variable.

3.1.2 Method and Design

The sample consisted of two small groups of German primary school children (3rd grade, n1=16, n2=17; female (n1)=12; (n2)=10; M (age) = 8,18 years). All children went to the same school and were taught by the same teacher, therefore were comparable regarding teaching methods. Furthermore, ANOVAs showed no differences regarding several control variables such as age (F=.662; df = 1; p=.422), overall competencies in English as a foreign language (F=1,898; df=1; p=.846) and reading abilities in English (reading text aloud; F=.042; df = 1; p=.84); These abilities were estimated by the teacher for each of the students on a five-point rating scale (one = almost never true; five = almost always true). Although these estimations do not derive from standardized tests, they are, however, based on consequently carried out, criteria-based oral observations and short written assessments connected to a textbook (reading, listening, vocabulary knowledge and writing), which were done every four weeks during the six months before the intervention took place.

Within the two parts of the study (EG and CG changed after four weeks), both groups of children were given eight different one page comic strips from an EFL reading book (Englisch-Stars 3; Gleich et al., 2013), four for each of the two phases; a new comic strip was presented every second week over a period of four months. Altogether, 48 new target words, i.e., words the children had not yet learned in the context of language instruction, were identified for each phase.

In both phases, the cartoons were introduced in class by the teacher. The respective experimental group (EG) was then instructed to use the reading pen (TING) for their reading practices, whereas the control group (CG) practiced reading the comics with their teacher for the rest of the lesson. Additionally, both groups were instructed to practice at home autonomously and to use a fill-in journal provided by the teacher for each student to note down how often they practiced reading aloud (EG = with reading pen / CG = without reading pen), as a measure for their reading motivation, frequency and duration of practice.

Altogether, the study consisted of 4 measurement points: During the first pretest (T1), reading fluency was assessed by asking each child to read a story aloud (consisting of target words from the first four comic strips). Furthermore, for the assessment of vocabulary pronunciation, the children had to read aloud each of the 48 target words. The results of both tasks were audio-recorded and rated by the teacher, one of the authors and a research assistant who was not involved in the study using a predefined rating system. Both variables were assessed again in a post-test after the first phase (T2). In the second phase of the study, EG and CG changed their roles, and four new comic strips were presented. Again, reading fluency and pronunciation were assessed by using 48 new target words from the new comic strips within a pre- and a posttest (T3 / T4).

3.1.3 Results

	Mean	Std. Dev.	Paired *t* test		
			t value	*df*	sig. (2-tailed)
Phase 1					
EXP.GROUP					
Fluency Pre	21.69	15.58	4.62	15	.00
Fluency Post	39.13	23.08			
Pronunciation Pre	16.92	8.75	9.69	12	.00
Pronunciation Post	27.54	11.22			
CONTROL GROUP					
Fluency Pre	26.53	19.55	8.89	16	.00
Fluency Post	45.11	22.71			
Pronunciation Pre	21.82	12.64	6.95	15	.00
Pronunciation Post	30.44	10.32			
Phase 2					
EXP.GROUP					
Fluency Pre	40.41	21.43	4.61	16	.00
Fluency Post	51.59				
Pronunciation Pre	24.82	9.71	4.88	16	.00
Pronunciation Post	30.76				
CONTROL GROUP					
Fluency Pre	34.56	21.97	3.54	15	.00
Fluency Post	42.75	23.11			
Pronunciation Pre	20.06	9.65	5.78	14	.00
Pronunciation Post	27.93	9.59			

Note. Exp-Group= Experimental Group. Experimental and Control Group changed after Phase 1

Table 1. Increase in fluency and pronunciation within groups (phase 1 and 2, t-tests for dependent groups)

With regard to group differences, several two-tailed t-Tests were conducted. Since groups did not differ regarding age and teacher-estimated abilities in EFL, control variables were not included. T-Tests for dependent groups were used to analyse the increase regarding fluency and pronunciation within the two groups.

Results for both phases of the study show a significant increase regarding fluency and pronunciation for both groups (Table 1). Therefore, both language models seem to fine-hone such foreign language skills. However, descriptive statistics also show a group difference with regard to language abilities (Fluency and Pronunciation) within the pre-test with an advantage for the same group in both phases (advantage for CG in Phase 1, KG in Phase 2), although they did not differ with respect to teacher-estimated overall EFL competencies. Therefore, t-tests for independent groups were conducted for phase one as well as phase 2 (Table 2).

	Exp-Group		Cont.Group				
	Mean	Std.Dev	Mean	Std.Dev	*t*-value	*df*	sig. (2-tailed)
Phase 1							
Fluency pre	21.69	15.58	26.53	19.55	0.78	31	.44
Pronun.pre	26.53	19.55	21.82	12.64	1.17	29	.25
Fluency post	39.12	23.08	45.12	11.22	0.75	31	.44
Pronun.post	24.73	11.22	30.44	10.32	1.47	29	.15
Phase 2							
Fluency pre	40.41	21.43	34.56	21.97	0.79	31	.44
Pronun.pre	24.82	9.71	20.06	9.65	1.44	31	.17
Fluency post	51.59	26.44	42.75	23.11	1.02	31	.32
Pronun.post	30.76	10.17	27.93	9.59	0.81	30	.43

Note. Std.Dev = Standard Deviation Exp-Group= Experimental Group. Cont.Group = Control Group; Experimental and Control Group changed after Phase 1

Table 2. Descriptive statistics and group differences (t-test for independent groups) phase 1 and 2

No significant group differences could be found regarding variance (levene-tests: p=.08-97). However, overall standard deviations are relatively large. This shows that there is a large spectrum of foreign language abilities within the groups. T-Tests for independent groups showed no significant group differences, neither for pre- nor for post-test scores (Table 2). However, this might be due to small sample sizes. Therefore, those results should be interpreted very carefully.

	Exp-Group		Cont.Group				
	Mean	Std.Dev	Mean	Std.Dev	*t*-value	*df*	sig. (2-tailed)
Phase 1							
Reading Frequency	29.50	13.18	14.00	8.25	4.08	31	.00
Phase 2							
Reading Frequency	30.00	24.47	23.38	8.79	1.05	31	.31

Note. Std._Dev = Standard Deviation Exp-Group= Experimental Group (practicing reading with pen). Cont.Group = Control Group (practicing reading without pen); Experimental and Control Group changed after Phase 1

Table 3. Differences in reading Frequency / Motivation

As a measure for reading aloud-motivation, children were asked to write down how frequent they practiced reading aloud at home. To find out whether EG and KG differed with regard to reading motivation, further t-tests for independent groups were conducted (table 3).

Results show that in phase one, the experimental group read significantly more often at home (table 3), which indicates a motivating effect of the reading pens; however, in phase two, observed differences were not statistically significant. Whether this is due to the small sample size, to an effect of the stories or to class effects, remains unclear.

Overall, the results of both phases seem to be comparable: a) within this first study, at least no significant group differences could be found with regard to fluency and pronunciation correctness, b) both groups significantly improved their fluency and pronunciation skills in both phases, no matter if they worked with the teacher or the reading pen as their input provider. Therefore, teacher as well as reading pen seem to be suitable language models, at least with regard to pronunciation and reading aloud fluency. Furthermore, at least in phase one, the experimental group also read significantly more often at home. Those results indicate that reading pens seem to motivate children to practice reading and might be a tool to provide additional "time on task" and opportunities for practice. However, it remains unclear whether the effect will remain stable over a longer period of time. Furthermore, the sample was very small, therefore results should be interpreted very carefully, and further studies should be conducted using larger samples.

3.2. Study 2

The second study focused on the effect of using a reading pen on English vocabulary, specifically on vocabulary pronunciation, knowledge of word meaning and spelling.

3.2.1. Method and Design

The second study took place approximately 2 years later, using a different sample of children. Again, the sample of the second study consisted of two small groups of third-grade children (n1=21, n2=21, f=24 (n1); f = 22 (n2); M (age) = 8, 54 years). All children went to the same school and were taught by the same teacher. Several control variables were assessed: The Raven Coloured Progressive Matrices (Raven et al. / German: Bullhäcker & Häcker, 2001) as a relatively short measure for non-verbal cognitive skills, and the family affluence scale (e.g. Currie et al., 2008) as a measure for socio-economic status. Due to time-based and economic reasons, it was decided for this second study to use a self-assessment scale as an approximation of English language proficiency (word knowledge, pronunciation, spelling, and writing). No statistically significant group differences were found (Table 4).

	Class 1 (EG-KG)		Class 2 (KG-EG)				
	Mean	Std.Dev	Mean	Std.Dev	F	sig.	Eta²
Age	9.23	0.36	9.12	0.42	0.71	.41	.02
Raven CPM	29.35	4.32	29.44	5.33	0.04	.95	.00
SES	10.56	2.99	11.00	2.52	0.22	.64	.01
EFL (Self)	9.36	2.30	9.11	3.70	0.07	.80	.00

Note. Class 1: Experimental Group (EG) in Phase 1, Control Group (CG) in Phase 2; SES = Socio-Economic Status Index (Computer at home, musical instruments, own room, number of cars, traveling, books at home) ; Std.Dev. = Standard Deviation; EFL (Self) = Self-Assessment of English as a foreign language

Table 4. Differences in reading Frequency / Motivation

Again, a quasi-experimental pre-post-cross-sectional design was chosen: the experimental group used the reading pen for practicing their knowledge and pronunciation of vocabulary, the control group practiced with their teacher. In both groups the vocabulary had been introduced once by the teacher (written and spoken form, pronunciation and meaning). Similar to study one, study two also consisted of two phases: after six weeks, the groups alternated, i.e., the experimental group became the control group working with the reading pen and vice versa.

First, two different topics children had not yet learned during instruction were identified: transport and shopping. Then, twenty target words were chosen for each of the two topics (n=40 target words). These words included cognates as well as words that differ significantly from the German language with regard to pronunciation. Furthermore, different parts of speech (nouns, adjectives, adverbs, verbs) were chosen. Examples for the topic "shopping" are "supermarket", "first floor", "to change" or "cheap"; examples for "transport" are "pedestrian", "to drive", or "slow".

At the beginning of the study, in a pre-test (T1), trained test administrators assessed students' vocabulary knowledge, pronunciation, as well as spelling for both topics in individual testing sessions. Then, during the next six weeks, children were asked to practice the new vocabulary for the first topic, "transport", at the beginning of each English lesson (i.e., two times per week) for about ten minutes. They used an English dictionary for primary school (Brune et al., 2017), which includes the two chosen topics, and which can be used either with or without the reading pen. The experimental group exclusively used the reading pen, while the control group only practiced with their teacher. 2-3 new words were introduced per lesson. After 6 weeks, children were tested again (T2) regarding vocabulary knowledge, pronunciation and spelling for the 20 "transport"-words. The two groups then changed their roles, and practiced the 20 new words for the topic "shopping" during the next six weeks. They were tested again regarding vocabulary knowledge, pronunciation and spelling for the "shopping" vocabulary after six weeks (T3).

4. Results

Again, with regard to group differences concerning control variables, Analyses of Variance (ANOVA) were conducted. Since groups did not differ regarding the above-mentioned control variables, those were not included in the analyses. T-Tests for dependent groups were used to analyse the increase regarding vocabulary knowledge, pronunciation and spelling within the two groups (table 5).

In the pre-tests (T1), the two groups did not differ significantly with regard to previous knowledge about the 40 words (table 6); therefore, effects due to previous knowledge were less likely. Also, in some cases, overall standard deviations are relatively large. This shows that there is a large spectrum of foreign language abilities within the groups.

In the post-tests, only two significant group differences could be observed (table 6) with regard to vocabulary knowledge for "shopping", and spelling for "transport". For both variables, class two scored higher. However, no clear conclusions can be drawn from these results: in the case of "spelling transport", class 2 scored higher in the role of the control group, in the case of "knowledge shopping" children in class two were the experimental group. Furthermore, those group differences refer to different topics as well as different vocabulary-related proficiencies. Therefore, it remains unclear whether the students of class 2 were able to benefit more from certain learning environments or language models, whether there are other class effects responsible for the higher increase in scores or whether effects are due to the small sample size. Those questions should be investigated in further studies with larger sample sizes.

To sum up, both groups were able to significantly increase their vocabulary knowledge, pronunciation and spelling, regardless of the respective language model and topic. Therefore, the conclusion might be drawn that, also with regard to vocabulary-related proficiencies, reading pens provide learning opportunities and a decent alternative to teacher-centred practice, which might especially be helpful during autonomous phases of learning and in-home study contexts.

	Mean	Std Dev	Paired *t* test		
			t value	*df*	sig. (2-tailed)
Phase 1					
EXP.GROUP					
Voc.Transport pre	0.40	0.82	6.53		.00
Voc.Transport post	5.50	3.46			
Pron.Transport pre	7.20	5.16	6.22		.00
Pron.Transport post	18.85	10.67			
Spell.Transport pre	0.60	0.75	2.65		.02
Spell.Transport post	1.55	1.81			
CONTROL GROUP					
Voc.Transport pre	0.63	0.76	5.57		.00
Voc.Transport post	5.90	4.31			
Pron.Transport pre	10.79	8.23	8.03		.00
Pron.Transport post	18.85	10.47			
Spell.Transport pre	1.42	1.80	3.56		.00
Spell.Transport post	3.90	3.29			
Phase 2					
EXP.GROUP					
Voc.Shopping pre	1.42	1.13	6.71		.00
Voc.Shopping post	8.63	5.45			
Pron.Shopping pre	12.95	6.33	9.74		.00
Pron.Shopping post	26.95	6.98			
Spell.Shopping pre	1.53	1.02	5.10		.00
Spell.Shopping post	3.30	2.43			
CONTROL GROUP					
Voc.Shopping pre	1.30	1.46	4.35		.00
Voc.Shopping post	5.30	4.80			
Pron.Shopping pre	8.30	8.93	14.47		.00
Pron.Shopping post	25.85	7.79			
Spell.Shopping pre	0.90	1.47	4.67		.00
Spell.Shopping post	3.24	2.45			

Note. Std.Dev. = Standard Deviation Exp-Group= Experimental Group; Cont.Group = Control Group; Experimental and Control Group changed after Phase 1; Pron.Transport = Pronunciation "Transport" Vocabulary; Spell.Transport = Spelling "Transport" Vocabulary; Voc.Transport= Vocabulary Knowledge "Transport". The same applies to "Shopping".Both groups increased their knowledge significantly in both phases and for both topics, no matter which source of input, i.e. language model, they used. Therefore, both language role models seemed to foster an increase of language abilities.

Table 5. Increase in fluency and pronunciation within groups (phase 1 and 2; t-tests for dependent groups)

	Exp-Group		Cont.Group				
	Mean	Std.Dev	Mean	Std.Dev	*t*-value	*df*	sig. (2-tailed)
Phase 1							
Voc. Transport pre	0.40	0.82	0.63	0.76	0.91	37	.37
Pron. Transport pre	7.20	5.16	10.79	8.23	1.62	37	.12
Spell. Transport pre	0.60	0.75	1.42	1.80	1.84	37	.08
Voc. Transport post	5.52	3.46	5.95	4.80	0.356	40	.72
Pron.Transport post	18.85	10.67	25.11	7.79	1.85	40	.07
Spell.Transport post	1.52	1.81	3.71	3.29	2.68	40	.01
Phase 2							
Voc. Shopping pre	1.30	1.13	1.42	1.46	0.29	37	.77
Pron. Shopping pre	8.30	6.33	12.95	8.93	1.88	37	.07
Spell. Shopping pre	0.90	1.02	1.53	1.47	1.55	37	.13
Voc. Shopping post	8.95	5.45	5.53	4.80	2.14	37	.04
Pron.Shopping post	26.95	6.98	25.85	7.79	0.46	39	.65
Spell.Shopping post	3.30	2.43	3.24	2.45	0.081	39	.94

Note. Std.Dev. = Standard Deviation Exp-Group= Experimental Group; Experimental and Control Group changed after Phase 1; Pron.Transport = Pronunciation "Transport" Vocabulary; Spell.Transport = Spelling "Transport" Vocabulary; Voc.Transport= Vocabulary Knowledge "Transport". The same applies to "shopping".

Table 6. Descriptive statistics and group differences (t-test for independent groups) phase 1 and 2

5. Summary & Discussion

In German primary schools, foreign language instruction time is limited to a few (two to three) hours per week. Yet, curricular guidelines aim at the achievement of an A1 level of the CEFR (Council of Europe, 2018) (at least) by the end of grade four. The aim of the project described in this paper was to find out whether digital reading pens provide additional, motivating and, with regard to language development, supportive autonomous language learning opportunities for students, inside and outside the classroom. Second, our research aimed to find out whether the use of digital reading pens can lead to comparable outcomes with regard to vocabulary learning (meaning and pronunciation) and reading aloud practice as the rather common "teacher-as-input-provider".

Two different explorative studies were conducted, both using a quasi-experimental pre-post-cross-sectional design. The investigation focused on different aspects: a. reading aloud competences (fluency and pronunciation; study one) b. vocabulary-related knowledge and skills (word meaning, pronunciation and spelling; study two). Results of the two studies pointed into the same direction: Both groups in both phases of both studies showed significant increases regarding all assessed aspects. Furthermore, with only two exceptions, groups did not differ significantly with regard to post-test-scores. Although, during the intervention phases of both studies, reading pens were used as the only language model by the experimental group, results in both conditions (reading pen/teacher) show no group differences in study 1, and only very few differences (in different directions and with no clear pattern) in study 2. Based on these results, we conclude that digital reading pens are suitable tools for vocabulary learning as they provide students with a reliable "language model". Reading pens may particularly be suitable during study periods in which no "analogue" language model is at students´ disposal, such as during homework or self-directed study phases within the classroom. This way input and practice time (time on task) can be increased.

Furthermore, we assume that reading pens may even increase students´ motivation to make use of such autonomous (and additional) learning opportunities. Especially the results of study one support

this assumption: In one phase of the study, children of the experimental group (with reading pens) read more often at home. However, it is important to emphasize that the study cannot give any answer to the questions whether such effects will remain stable over a longer period of time. Additionally, since the sample was very small, results should be interpreted very carefully, further studies should be conducted to verify our results in larger samples.

For now, based on our results, we suggest balanced combination of a teacher-related and a digital device-related approach. Reading pens can be used for practicing reading texts at home that include familiar words or vocabulary that has been introduced at school. They may also be helpful in autonomous study phases, as the teacher is no longer the only answer to student-typical questions such as "how is this word pronounced in English?". Doing so, valuable teacher capacities can be released for tasks whose success in terms of language progress, depends more on the teacher, e.g. activities that focus on spontaneous, unplanned discursive speech, free writing etc. Moreover, reading pens may simply be used to increase practice time (time on task) outside the classroom. Young learners are obviously motivated to make use of the tools, which at the end of the day, can lead to more input time for each student, if they are allowed to take them home and use them there.

Furthermore, especially when autonomously working on a task whose desired outcome is an oral presentation, learners can use the digital pen to reassure and practice the right pronunciation.

In a nutshell, we propose that digital reading pens may be seen as valuable digital "helpers" in terms of vocabulary and reading practice in Early Language Classrooms. One clear limitation of the project is the fact that both studies used relatively small samples, and are therefore small-scale studies. However, the fact that the results of both studies point into the same direction (although slightly different abilities were assessed), is a first indicator that results might be generalizable beyond the samples. Still, results must be interpreted very carefully.

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