

Self-Regulation and Training of Students with Learning Disabilities in an Inclusive Setting Using ICT

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Abstract Methods that improve the learning performance of students in heterogeneous learning groups are constantly being sought after. The aim of the present study was to explore the possibility of using the smartphone to improve student classroom preparation. For this, a free app was used, which reminded the students on the content that needed to be learned and tasks that needed to be finished. This was done with the help of the devices that the students bring themselves ("Bring Your Own Device" - BYOD). The results of the study indicate a possible greater learning achievement by the users of the app when compared to the non-users. However, the use of the students' self-managed devices was also the cause of significant problems. These were identified through the use of log sheets which discovered the root cause of success or failure. The study was conducted in two eighth grade classes, with a total of 48 students from a middle school in the subject of chemistry. The study's finding, that the use of reminder apps significantly raises learning outcome, is significant for chemistry lessons.

Keywords: *ICT, learning companion, inclusion, self-regulation*

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1. Introduction

In Germany, since 2009, students with a recognized need for special support during learning, e.g. children with mental, physical or learning disabilities, have the right to an inclusive education [1]. The convention was ratified on March 23rd, 2009 and resulted in a significant increase of students with learning disabilities entering common schools [2]. As a result of this, more attention must be given to the individual learning processes and the assistance of students over and above what was already mentioned in the PISA (Program for International Student Assessment) study from 2000 or the TIMSS study (Trends in International Mathematics and Science Study) of 1995 with regard to heterogeneous learning groups. Considering the Hattie study [3], it became apparent that the most effective factor of learning is self-regulation, which has an effect size of $d = 1.44$ [3], p. 53]. According to Klieme, Artelt and Stanat, "The core area of self-regulated learning is the ability of students to select, combine and coordinate learning strategies" [4], p. 175]. It is here that the planning of the learning objective and the use of necessary resources required to achieve the learning objective are of great importance. In this case, students with learning disabilities participated in the study side by side with students without disabilities, in an inclusive setting.

We chose this topic to investigate the daily experiences of teachers in German schools. It has become apparent, that the colleagues who teach in inclusive classes are

not trained for such tasks and thus cannot meet the requirements of neither pupils nor parents regarding a mutual, yet individual education. Smaller problems arise due to not knowing to whom to turn for help as well as a lack of knowledge about corresponding support systems.

The first author of this study, being headmaster of a school, was able to gain insights into the situation of pupils, regardless of their status as inclusive children or not. In addition, other teachers from this school repeatedly reported being overwhelmed by the conditions of inclusive education. The combination of both aspects motivated us to deal particularly with the subject of inclusion. It is of main interest for us to explore criteria for improving learning, such as to provide both students and teachers with practicable tools for meaningful interventions in an inclusive classroom setting.

Hattie states that learners can assess their level of performance relatively accurately [3]. Here, he is referring to a study by Kuncel, Crede and Thomas [5]. However, this study also states that "... this applies to all learners, except those from minorities, who have lower grades than non-minority learners." [5] p. 52]. This suggests that students with disabilities could belong to these minorities. On the other hand, according to Hattie, these expectations of success can also lead to the possibility of (...) only showing the degree of performance that corresponds to their own expectations of their performance" [5], p. 53]. Therefore, the satisfaction of the students' own performances was investigated in this study, as it provides information about the expectations of success which a student has for himself. Criticism of Hattie's conception is practiced,

amongst others, by Terhart [6]. Terhart draws from Beywl and Zierer, who explicitly point out "(...) that an isolated consideration of the effect sizes of individual factors is questionable" [6, p 173]. On one hand, they cite factors that have a low effect size but, when combined with other factors, produce powerful groups of factors. Hattie himself explicitly described this. He states that "team teaching [...] has a low effect size of $d = 0.19$ but in combination with for example peer tutoring ($d = 0.55$) this results in a powerful bundle of factors" [3, p.9].

Since teaching and learning are always influenced by many different factors, such as the students' prior knowledge, the interaction between student and teacher, the interaction between the students, the motivation in the respective subject and the subject matter, etc., it is questionable as to whether it makes sense to look at individual factors in isolation and to then draw conclusions. In such complex contexts it, thus, becomes necessary to focus on one effective variable and hereby enabling an investigation into how strongly a change in this one factor has an effect on the result. From our point of view, teachers often ask for individual adjustments that would enable them to focus on just one thing without having to question all their teaching and also safeguarding against losing track of their lesson preparations. This is why we deliberately chose self-regulation as an effective factor, as well as to achieve statistically meaningful results in the research part of the study.

In order to improve teaching outcome, it is necessary to identify and change individual influences and thereby to improve the quality of teaching in terms of lesson results. Consequently, it must be borne in mind that, in the context of this work too, the findings cannot be regarded as separate from other teaching activities taking place in a classroom. For instance, self-assessment of one's own performance level involves a high correlation of reflection in cooperative learning processes.

This resulted in the following research questions:

1. Can students be provided with learning companions to be reminded of their homework automatically without significantly afflicting teachers even further?
2. Can smartphones that are owned by students themselves be used?
3. Can the learning performance be enhanced by reminding the students of their homework with their own devices?
4. Are students even willing to use their own devices for this kind of reminder?

Current literature provides many examples concerning the issue of inclusion and digitalization in chemistry. Amongst others, A. Adesokan and C. Reiners dealt with the inclusion of hearing-impaired students in chemistry class [7]. J. Huwer and R. Brünken, in their leading article "natural sciences in new paths" [8], dealt with the individualization in teaching with the aid of tablets. ICT was inspected with regard to its function as learning companion, learning tool and experimental tool. In the article "successful inclusion with media integration" ("Gelingende Inklusion mit Medienintegration"), meaning "successful inclusion with media integration", M. Brüggemann, S. Welling and A. Breiter illuminate the possibilities for the potential of individual support of learning processes and the possibility to flexibly match

these learning processes to the needs of most different users [10]. A. König, M. Risch and R. Reuter are taking a different path with their studies on the potential of digital learning guides with a view to the diverse functions of information and material offerings [11].

This exemplary excerpt from current literature shows that the impact of digital learning companions as a reminder on homework performance through the use of a to-do-app has not yet been the subject of research.

2. Method and Procedure

As a starting point for the study, an experiment to produce copper sulfate was chosen. The students carried out the experiment and documented it in the form of an experimental protocol. The protocol could be started during the lesson and it was expected to be completed at home. The students were aware that the experimental protocol would be graded. The average grade in the inclusion class was 4,3 compared to an average of 4.6 in the regular class. Subsequently the students filled out a questionnaire attributing the causes for success or failure. As a methodical approach we chose survey instruments for action regulation approach according to Emmer [12], which were adapted for the empirical study. The study took place in two 8th grade classrooms of a secondary school in Sigmaringen, Germany. The participants consisted of a total of 48 students, girls and boys, as well students with and without disabilities, all in between the age of 13 to 15 years old. The two classes had prior been divided in one inclusion class and one regular class. The inclusion class consisted of 20 students, the regular class consisted of 28. This kind of division of the two classes had already existed before the study and also continued like this after the 3 months study period. During this period different learning settings were used, e.g. open learning, teacher instructed learning and experiments. During the study, one simple task was added to the teacher's regular role and function. The teacher was required to set reminder for the following week within the app containing the tasks he already mentioned and noted in class.

3. Results

In the preparatory survey 92.3% of the students in the inclusion class were dissatisfied with their results i.e. their grades; 7.7% were satisfied with their performance. In the regular class, 71,4% of the students were dissatisfied with their results and 28,6% of the students were satisfied with the performance or grade. At this point it should be mentioned, that the satisfaction says little about the grade, but about the expectations of success which a student has for himself. Some students were satisfied with their grades because their grades reflected their willingness to exert themselves or were in accordance with their self-esteem. Thus, for example, students with grades below five, stated they were satisfied because, "I did not make an effort".

The reasons students gave for their poor performance were as follows: 58,3% and therefore the biggest group said "they forgot", "they did not feel like it" and "they did not do the work". A further 16.6% of the students said that they had lost their experimental protocol.

Another result of the survey was the self-assessment of the students regarding their performance: 16.6% of students said they were dissatisfied with their performance because of "their bad grades". This leads to the assumption, that some students were just dissatisfied of their performance because they got the bad grade, which, again, reflects their own expectations of success. Further reasons given were: "The experiment did not work" with 4,2% and one two participants stated that their "German skills were insufficient" with another 4,2 %, thus, not enabling them to fill out the experimental protocol.

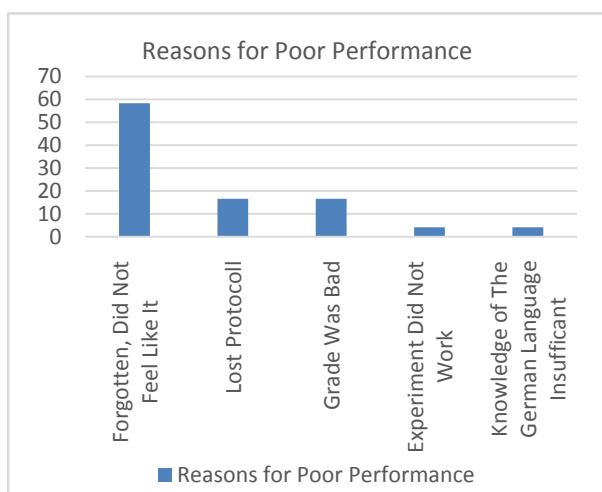


Figure 1. Students' reasons for their poor performance

On the other hand, 95,8% of students, combining both, students who completed the task and students who didn't, said that writing the experimental protocol was or would have been an easy task, and 93.7% felt that the task did not take/ would not take much of an effort. When asked what they would do differently next time, 72.7% of the students answered, "I would take more time and work on the tasks in more detail". 19.8% answered "I would do the tasks and submit them". The remaining students said, they wanted to "make more of an effort". This could be interpreted as a positive effect on the research question, if students can enhance their learning performance by being reminded by an App on their own device. Thus, the use of ICT became the focus while seeking a solution. For our purposes "digital learning companions" [8,9] were chosen. These are apps which fall under the to-do-apps category.

What would the students like to do differently?

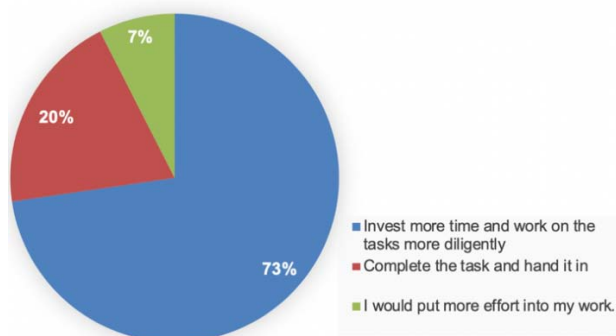


Figure 2. What would the students like to do differently?

As a result of this, a program to improve self-regulation was carried out in the inclusion class for 3 months. This involved various methods of self-regulation. At the beginning of the lesson, various variables which correlate to learning were discussed, such as active listening, the importance of sleep, rules and rituals, coping and dealing with learning difficulties and self-esteem.

These were discussed respectively during the first five minutes of each lesson. The students were given homework and various short ungraded learning assignments on a weekly basis. Grades were compared at the end of the school year.

4. To-Do-Apps as a Learning Companion

During the discussion of answers with the class, students expressed the desire to be reminded more often of the tasks to be completed, since in grade eight, there is only one lesson a week of chemistry. Everyday experiences in school show that students of this age are not organized enough to plan and complete their homework without structural help. Thus, it turned out that an effective learning companion, e.g. an App, was needed. We reacted on the suggestion of the students' need, for tips and reminders during the week and decided to offer them the assistance they themselves had requested. Because science subjects in Germany, during the grades 5-10, are not rated very important and students have only 1 to a maximum of 3 lessons of science a week, the support in these subjects cannot be done through the direct communication between teacher and student. In our case, chemistry is taught for merely one lesson per week. Hence, the usage of ICT as solution moved into focus. So-called "digital learning guides" [9] can be considered here. Apps that can perform such tasks should be grouped together in the "to-do-apps" category. Some are already preinstalled on many devices, but there are also plenty of other applications in various app stores. The decision was made in favor of the to-do-app named "Wunderlist", as this app is in Microsoft's product portfolio and is thus compatible with the software, which the students are used to using. Furthermore, the app is available on all platforms, e.g. as well iOS and Android. Wunderlist provides the ability to send a set of tasks to people and remind them at different times to complete these tasks. The participants simply have to enter their email address and download the app free of charge. Since the app should be installed on personal devices of the students (Bring your own device, BYOD), the consent of the students was needed. 78.9% of the students agreed to use the app and after providing their email addresses, the students were sent a link for the installation. This app was then used over a period of 3 months.

5. First Experiences

The to-do-app was successfully installed by 18.8% of the students. Both, the regular class and inclusion class students had been invited to install the app and therefore could have installed the app. It needs to be mentioned here, that the control group was not a selection rather than a formation of students who were not able to install nor use

the app. The non-user group, as well as the user group, was composed of a heterogeneous group of students: different genders, age between 13.5 to 15.8 years old, varying performance levels, as well as students with and without disabilities. Reasons for the low number of users were given as follows: 35.9% - a lack of interest in the app, 10.3% said that they were not able to register and 7.1% stated that the link did not work. 17.9% of the students reported that the invitation link had landed in their spam folder. 7.1% of the students mentioned that the reason not to install the app was that the memory space on their smartphone was occupied, 7.1% claimed that they had forgotten to install the app. 10.3% of the students did not have their own e-mail address, instead provided the address of their parents and therefore could not access the link or install the app on their own device. 3.6% were unable to register for unspecified reasons.

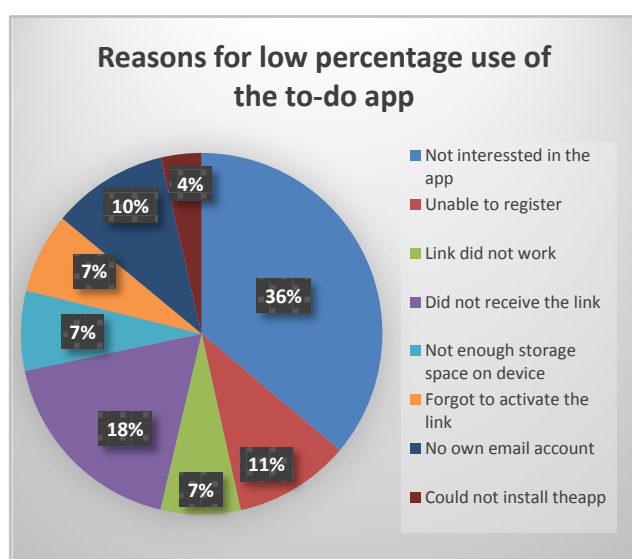


Figure 3. Reasons for low percentage use of the to-do app

In the following weeks, the tasks to be completed were written on the board, as well as announced in the app to those students who had successfully registered with the to-do-app. Therefore, the students were provided with the same assignments and work plans during chemistry class. In addition, the students who used the app were reminded to complete the tasks typically two days prior to the next lesson. Those reminders were, to some extent, structured as follows. When preparing for an exam, for example, all students were given the entire instructions in class. The students who used the app were reminded to prepare for the test throughout the time to the set date of the exam. The reminders were organized in small parts to constantly provide broken down steps coupled with daily tasks. Thus, the students should be prepared for the test (exam) by assisting them to plan and learn via short daily practice sessions. Non-users were to organize their own learning arrangements. After a learning period of four weeks, the classes were able to improve the grade point averages from 4.3 to 3.9 in the inclusion class and from 4.6 to 4.0 in the regular class. This was the first investigation period.

All the students, who made use of the study reminders which were sent via their smartphone said that the app had been very helpful to them. Following reasons were given:

- more "goal-orientated" learning

- the regular reminders to do their homework and study helped them to accomplish the tasks
- one student stated, that he was already annoyed to be reminded by his smartphone to study.

86% of the students who had not used the app said they would definitely use the app the next time.

These latter students gave a very positive feedback in the questionnaire on causation attribution and expressed an interest in using a to-do-app in the following school year. Reasons given by the students were as follows:

- "The app helped me to learn because I was reminded to do so"
- "I felt that I knew exactly what I should learn because the tasks in the app were written down precisely",
- "It was good that the app had scheduled small tasks for each day".

62% of the non-users were more likely to blame external factors for their test performance. For example, answers to the question "What suggestions do you have, that can help you learn / do homework" were as follows:

- "stricter parents",
- "a more exact discussion of the work plan by the teacher",
- "fewer tests per week",
- "ungraded exercises before the test (Ready For Test RFT)"

Further 28% of non-users indicated intrinsic reasons for their behavior. They named for example:

- "I should spend less time on computer games",
- "I should have learned more",
- "I should do the things discussed in class",
- "look into the book"

The remaining 10% made no comment.

The students who used the app for learning were able to improve on average by 0.75 points, the students who did not use the app were only able to improve by 0.4 points, which speaks for the use of the app. Everyday teacher experience shows that students improve their performance in the second half-year to end the school year with best possible grades. Nonetheless students who used the app were able to improve their grades by additional 8,75% compared to the non-user group.

6. Conclusion

The students who used the app had a report average of 2.9 by the end of the school year. The non-users of the app averaged 3.7 in their chemistry grades. This shows the tendency that the usage of the app constituted a clear advantage to the students.

Students ask for support from learning facilitators (teachers, parents, or media) to remind them to do their homework and learning tasks. The smartphone appears to be a viable factor. On closer inspection, however, we encountered great difficulties. Students cannot be forced to install software on their home devices, nor can they be forced to make use of the app, although most students were willing to make use of their own device. Another problem encountered was that some students had difficulty setting up the software, caused by a lack of media literacy for example. This raises the question, as to whether these

hurdles can be removed by the use of hardware (e.g.: tablets, smartphones, laptops, etc.) provided by the school. Yet, there are currently only a few schools that have this equipment with appropriate Wi-Fi coverage. For this purpose, the so-called "digital pact" was created in Germany, which aims to equip the German schools with the necessary hardware and software [13,14]. Further studies could also show that AR can represent new ways to promote self-regulated learning [15,16,17,18]

Apart from this, the extra work for teachers limits itself to a minimum and is therefore of no consequence. Furthermore, the app can be used in any kind of learning setting, such as open learning, teacher instructed learning or experimental settings, as it will support the students to fulfill their tasks. Furthermore, it is an example of how "digitality" affects the learning process and how teachers can use this in promoting learning [19,20].

It remains to be seen whether this will be of help and can address the problem in the long term. In addition, it now becomes necessary to investigate how such learning companions can be optimized so that more students will make use of the self-regulation offers in their free time. Also, apart from learning companions, more research on the result of this study must be done as to investigate if the tendency is still the same in larger focus groups.

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