EASY TECHNOLOGY DESIGNS FOR INNOVATIVE LEARNING

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ABSTRACT

In this text we describe a technology-based approach which uses just a small set of technological requirements to offer innovative learning within the DISK-Online approach. In times of pandemics it is crucial to provide solutions for education which are easy to access. Teachers and trainers need solutions which let them connect to their learners without having to be experts in technology and without having to use too much special equipment. This is especially important in the field of vocational education and training (VET). In this article we provide insights into the approach and some impressions gleaned from first tests in the field of VET.

KEYWORDS

DISK-Online, Innovative Learning, Technology, Hybrid Learning, COVID-19, Streaming

1. CHALLENGES IN THE FIELD OF TECHNOLOGY IN EDUCATION IN TIMES OF COVID-19

The COVID-19 pandemic affects the whole world and many countries have implemented safety regulations. People have to make sure that they keep their distance, observe hygiene and in many cases use a mask every time they leave their homes. This influences our daily lives with particular emphasis on work and education.

With regard to education we can see different ways of dealing with the challenges. Some countries focus on home schooling and digital approaches, some on small groups and keeping distance at school. With all of these approaches digital solutions have become more important than ever for schools and education providers.

One of the key concerns besides the digital and didactical competencies needed by teachers and trainers is the technical equipment of the school or education provider. Technology is shifting and schools are struggling to keep up with the equipment they need in order to stay in contact with the learners via online technologies. This means a school or an education provider needs a stable and fast internet connection and fast and accessible Wi-Fi. For teachers and trainers it is very challenging to teach in a digital way, when not every classroom offers internet access. The simple exchange of files doesn't have very steep technological requirements. Sharing a pdf file can easily be accomplished with low bandwidth. However more complete pedagogical and didactic approaches, such as interactive apps that connect audio and video, may have much greater requirements than are typically available to an instructor.

Interaction between teachers / trainers and learners is crucial. In the learning process feedback and immediate response are very important as well as the ability to form a connection though visualization with the person teaching the topic. Here broadband is needed. This need goes hand in hand with the need for technical equipment such as computers, laptops, tablets and interactive whiteboards. Having this equipment readily available allows the instructor to use them directly within the learning process.

In addition to that, data security is becoming extremely important due to the fact that we are dealing with personal data and individual learning processes.

The learners must also have access to a computer, a laptop, a tablet or a smartphone, plus internet access at home to allow for schooling at home and online learning to work. Today, many learners have access to smartphones but the restrictions of such technical environments, such as small screens (Maniar and et. Al. 2008), also affect the available methods of teaching. 3PLearning states that it is one of the most important issues to "assess whether your students have reliable access to technology" (3PLearning 2020) before eLearning gets started.

Moreover the learners or students often encounter technical difficulties that such platforms are apt to have. For schools, education providers and especially teachers and trainers this means that they have to be able to react to such technical questions and provide ways to find a solution.

Mehdipour and Zerehkafi in 2013 listed technical challenges for M-Learning, including:

- Connectivity and battery life
- Screen size and key size [...]
- Meeting required bandwidth for nonstop/fast streaming
- Number of file/asset formats supported by a specific device
- Content security or copyright issue from authoring group
- Multiple standards, multiple screen sizes, multiple operating systems
- Reworking existing E-Learning materials for mobile platforms
- Limited memory [...]
- Risk of sudden obsolescence [...]" (Mehdipour & Zerehkafi 2013, 97)

All these aspects are cost intensive and solutions are needed which don't put a financial burden on learners. Solutions should not require more than a browser for the learner which makes it easier to handle and access. Ease of access is also an important consideration for teachers. We therefore offer the following approach, which combines low technological requirements with easy access and maintaining the human face of teaching.

2. THE DISK-ONLINE APPROACH - EASY TO HANDLE HYBRID LEARNING

A possible solution we created in 2020 is the DISK-Online approach (Beutner & Pechuel 2020). The DISK-Online approach is focused on hybrid learning (Beutner & Pechuel 2020b) and therefore offers opportunities for eLearning which combines face-to-face learning with online learning via a streaming concept (Beutner & Pechuel 2020c).

DISK-Online stands for Didactic Interactive Streaming Know-how and this approach is designed for dealing with the challenges of COVID-19 and the technologic challenges at schools and education.

Our DISK-online approach is a basic approach which can be expanded. In its core setting it comes with four DISK implementation stages. These stages address different sets of increasing blended interaction, beginning with a first stage, where interaction is quite low and focused on the teacher and goes up to the fourth stage, where interaction is learner-centered and moderated by the teachers and trainers. To accomplish this DISK-Online uses streaming of lessons, courses and lectures via a streaming platform and the use of an easy to handle streaming tool like Streamlabs OBS.

Before we have a closer look at the technical issues we would like to introduce you to the DISK-Online approach and the step-by-step process to implement and enhance hybrid learning and teaching. DISK-Online makes it possible for a teacher to be separated from the learners who are all connected online. However, usually the concept works with a group of learners who are on site while there are other groups of learners who are not in the classroom. Hybrid learning offers the chance to use technical equipment and smart pedagogic designs to cope with challenges which we are currently facing in schools. The DISK-Online approach offers education with increasing levels of interaction via digital tools. This increasing interaction is described from DISK 1 (low teacher centered interaction) to DISK4 (learner centered interaction) and can be used at different schools to adjust the teaching to technical restrictions and digital teaching competences. The following paragraphs provide an overview on the increasing interaction from DISK1 to DISK4:

DISK1

In the first implementation stage which we call DISK1 students are split into an in-class group and an online group. Interaction between learners and the teacher takes place in the classroom. The lesson is made available via streaming on the Internet. For the online learners there will be no two-way interaction at this point. The teacher can also decide to make the stream available as a video. In this case learners can choose to watch the video at their own convenience depending on their personal schedules. Again, this method doesn't have any interaction. It is recommended that learners who follow the stream online take extensive notes to interact with the teacher when groups are switched and they become the in-class group.

DISK2

The second implementation stage, DISK 2, offers Interaction on a local level in the classroom and online via the Internet. The teacher offers the lesson via live streaming and the online students are able to communicate in real time with the teacher, just as the students in the classroom do. The online learners use easy to access tools such as the chat available in the streaming service or other messaging services to talk to their teachers. This allows the students to make comments or ask questions, allowing them to make the same sorts of contributions to learning as they would in the classroom. The stream can still be recorded and made available later for on-demand viewing, but in that case there is no additional interaction.

DISK3

Within the third implementation stage, called DISK 3, interaction takes place both in the classroom and via the internet as in DISK 2. Online students continue to be able to engage in real-time interactions with the teacher. However, in this stage, online students will be able to interact with each other using chat or voice chat or video chat options. The learners are collaborating and the role of the teacher transforms from presenting and lecturing to monitoring and guiding the interactions of the peers. The entire lesson will be available via stream and all learners, regardless of location, can interact with the teacher and with their group. The learning process is enhanced with both questions as well as engaging in discussions. In this stage the stream can also be recorded for later viewing just as previously, without the ability to interact, of course.

DISK4

Implementation stage 4, called DISK4, offers the highest level of interaction. In addition to the interaction opportunities of DISK 3 the learners in the classroom now also get the opportunity to discuss and interact with the online learners. The teacher role is now completely shifted to a moderator role which supervises and fosters the learning processes. The lesson is available via streaming on the internet and the learners are active in the learning process and involved in the structure of teaching and learning. The learners are working together in mixed groups which can include on-site and online learners. Optionally, the stream can be available as a video. Usually this is means that interaction will happen via mail or via comments over a longer time period.

3. TECHNICAL REQUIREMENTS AND RESTRICTIONS WITHIN THE DISK APPROACH

From a technical point of view, it is possible to provide a system in which everything is preconfigured in such a way that teachers only have to start the devices and switch them off after their lessons. Especially at the DISK1 level the necessary technical knowledge of teachers is reduced to a minimum. This means that existing devices can be integrated without any problems.

From a technical point of view the following technical components are necessary:

Hardware:
1. Internet Connection

It is important for schools to have a fast internet connection in order to be able to stream videos. The upload speed is particularly important for streaming. Streaming videos requires a minimum of 5 Mbit / s. It should be noted, however, that the official figures given often do not correspond to the speed available in practice. There are a number of websites that can be used to test actual speed. The important key figure here is the upload

speed. Note that multiple streams running at the same time (which would happen if multiple teachers were streaming at the same time) must share the available Mbps (megabits per second) between the different streams.

If the school already has fast Wi-Fi, no device is required. Otherwise it is recommended to install a powerful wireless router to make connecting easier. The role of a wireless network is to connect devices such as tablets to the school's internet connection without the need of connecting cables. It is highly recommended not to open the Wi-Fi network used for streaming to students. As with internet connections, too much traffic can slow down a Wi-Fi network. Wi-Fi routers are now standard, and are usually installed when the school is connected to the Internet. There is a wide range of wireless routers available. The most important requirement is that teachers get a good signal from the network when streaming (full bars if possible) and that the router offers a speed higher than the speed of the internet connection.

2. Projection in Classroom

Ideally, classrooms will have projectors that are ceiling-mounted and have a wireless connection. In the simplest case, projection walls can be a white wall, but corresponding projection surfaces increase the image quality. There are many modern projectors that support wireless connections. This means that a teacher can connect very quickly and share the screen with the projector so that the students in the classroom can follow the lesson. However, it is also possible to connect projectors to tablets with cables. In most cases the teacher only needs an adapter to the HDMI cable of the projector.

The role of the projector is to make the screen of the tablet visible to the students in the classroom. If no students are present, the projector can be ignored. When choosing projectors, the light intensity is particularly important. The required light intensity depends on the size of the projection surface. A value of around 500 lumens / m² is recommended (if you have an area of 4 m², the brightness should be around 2000 lumens). In addition it is advantageous to use projectors that can transmit images wirelessly, so that teachers do not have to spend a lot of time setting up and therefore do not lose time unnecessarily.

3. Tablet and Digital Pen

When it comes to tablets there is a wide variety available and teachers should choose the tablet that they are comfortable with. Almost all tablets are suitable for streaming. From entry level Android tablets to higher level tablets like the iPad Pro or even touch-sensitive screens with integrated computers running Windows 10, there are many choices for teachers. A big screen size is a plus, making it easier for the teacher to use the tablet like a blackboard/whiteboard. When it comes to choosing the tablet, the operating system plays a big role. From a maintenance point of view Android and iOS are a lot easier than Windows. In general teachers should choose the system that works well for them though. Of course, streaming can also be done with computers or laptops, it is just not as comfortable as using tablets.

Choosing the digital pen is very important and teachers are encouraged to try out which pen works best for them. There are big differences in quality. Some pens are worse than drawing with a finger on the screen while some modern pens achieve results that resemble writing with real pens.

4. Microphone

A good microphone is also essential. Many tablets are good at picking up sound with their internal microphones but viewers can usually feel the difference between internal microphones and external microphones that are connected to the device. For teachers the easiest solution could be a simple microphone that clips to the shirt and has a wire that plugs into the microphone port on the tablet. Sometimes an adapter is needed, depending on the tablet. For teachers who move around a lot there are wireless microphone solutions available that usually connect to the tablet via Bluetooth.

Software

1. Streaming Software

The role of the streaming software is to send the content of the tablet screen to a streaming platform as encoded video. A simple and free solution for this would be the program Streamlabs OBS, one of the most popular choices used by many streamers world-wide. The program is available as an app for iOS and Android and already comes with pre-configured settings to connect to some of the most popular streaming platforms. However, there are other choices for streaming software, especially if teachers decide to developer greater skills in this area. Streamlabs OBS covers everything that is needed though and allows full customization of the streaming layout so that teachers can even add chats and other elements of interaction.

2.   Streaming Platform

The role of the streaming platform is to make the video stream available to the viewers through browsers. Teachers who want to stream need to register an account at a streaming platform (which is normally free). When it comes to choosing streaming platforms, there are also a few choices. The biggest streaming platforms are YouTube and Twitch. Both can be used freely and without requiring the students to register. However, they also don't offer good solutions for protected environments ich which teachers can easily limit the classes to their students. Considering topics such as data security and preserving a protected learning space calls are getting louder for school authorities or ministries to provide a streaming platform solution for schools that takes the difficult decision of how to deal with the aspect of student data on the internet out of the hands of teachers.

3.   Whiteboard Software

Strictly speaking no special software is needed, however, it can support the teacher greatly. The easiest solution would be using any drawing program with a white background that the teacher can write on. More and more apps offer writing support for digital pens though, and they have the advantage of making it easier to save the screens or quickly open screens the teacher prepared in advance. There are specific blackboard /whiteboard apps that have more support functions but these are generally not free. Of course, apart from writing on a blank surface there are countless opportunities to use other apps, such as presentation apps, maps, videos, mathematical apps, etc. that can be integrated into the lessons.

When aiming for the higher DISK levels the following advanced components become necessary:

1.   Video Camera

Most tablets come with a video camera. If teachers choose to be visible to the students, they can add a video of themselves to the stream, thus making it easier for the learner to relate to the teacher. Streaming software like Streamlabs OBS makes it easy to overlay a small image of the presenter over the screen presentation (in one of the corners, for example).

2.   Chat Software

Chat software is a great help in making streaming more interactive. Some streaming platforms (like Twitch) already have integrated chat systems that can be used directly. However, it is also possible to integrate other chat systems, such as Discord. Discord is freely available and allows users to create chat servers for private groups with topic-related threads. Thus it could be an ideal tool to support group work.

3.   Voice Chat / Video Chat Software

Voice chat software could greatly support the connection between remote students, especially in group work. There are many voice chat systems available, such as Google Hangouts, Skype, Google Meet, Zoom, Telegram, Slack and many others. Discord also supports voice chat for large groups. If seeing each other is important students could also use video connections. However, teachers need to tread carefully in order not to be accused of being too careless with the security of student data when it comes to sharing images and videos of the students themselves.

4.   Advanced Learning Systems

There are learning system that structure interaction between students and teachers and can greatly support remote teaching. When these systems support interaction, they are a valuable addition to achieving the higher levels of the DISK approach. One example is a systems like Microsoft Teams which supports text, voice and video communication and sharing of files and assignments. Another example is Google Classroom which also structures assignments and supports group work. Another system that was specifically developed for schools in Germany by the Hasso Plattner Institute with data protection in mind is Schul-Cloud. While these systems all have the potential to greatly enhance interaction and structure the online learning process it will probably still take a while until teachers and schools are ready to use them on a greater scale.

4. TEACHERS' FEEDBACK CONCERNING TECHNICAL EQUIPMENT AND INTERNET CONNECTIVITY

In October 2020 we conducted a survey concerning technical equipment and internet connectivity at school. 104 teachers at VET schools answered a short questionnaire concerning their technical environment at school. All teachers came from Germany and therefore only provide insight into the current German situation. 33 of the teachers came from North-Rhine-Westphalia (31,7%), 25 from Rhineland Palatinate (24 %), 24 from Hesse (23,1%), 18 from Brandenburg (17,3%) and 3 from Bavaria (3,8%). Therefore, not all German member states (Länder) were involved and the Western part is slightly overrepresented. Nevertheless the results are very similar in the different regions. 49 teachers were female (47,12%) and 55 teachers male (52,88%).

When asked about the quality of the internet connection the following answers painted a clear picture of the situation in schools:

'At school the headmaster / the administration of the school has connection to the internet' – 99% (103 teachers) agreed and one person did not answer.

'At school, we have PC rooms without connection to the internet' – 46 persons agreed (44,2%).

'At school, we have PC rooms with connection to the internet' – 84 teachers agreed (80,7%).

However, when it came to the item 'At school, all teachers have connection to the internet', only 52 teachers agreed which is exactly 50% of the responding teachers.

And regarding the item 'At school, all classrooms have connection to the internet' only 6 teachers (5,77%) could agree.

With regard to Wi-Fi the positive answers are not much better. Only 7 teachers (6,73%) stated that there is Wi-Fi at school ('At school, we have Wi-Fi').

Moreover, concerning the learners, 12 teachers (11,54%) agreed with regard to the item 'At school, all learners can access the internet'.

The teachers were also asked to estimate how many learners have access to the internet via smartphones, tablets, PCs or laptops from home (regardless if this is their own device). The mean of the estimate of the 104 teachers is 87%, which means that the teachers think that on average 87% of the learners have access to the internet. This is lower than the results of a survey of STATISTA 2020 which found that in 2019 97 % of youths in the age range of 12 to 13 as well as 97% of youths of the age range of 14 to 15 and 97% of youths of the age range of 16 to 18 have access to the internet. In the survey of 2014 the number was even higher (2014: 98% of youths of the age range of 12 to 13; 99% of youths of the age range of 14 to 15 and 100% of youths of the age range of 16 to 18).

Therefore, it seems that teachers estimate the number of learners who can access the internet too low.

With regard to equipment 48 teachers (46,15%) stated that they have laptops at school, 35 teachers (33,65%) agreed to the fact that they have smart boards at school. Moreover, 93 teachers have their own laptops or PCs which is 89,4% of the teachers responding in our survey.

5. CONCLUSION

These numbers show that there is a need to support schools and provide them with good internet access and equipment to foster the learning and teaching processes. The political will to provide schools with better learning technology seems to be heading in the right direction but efforts must be intensified. However it is not only the technical equipment, but it is crucial that the competences of the teachers are strengthened to know how to use these tools, software and hardware to their best advantage. There is a need to train teachers, to provide them with in-service training and to support them. For the future it is crucial to have good equipment combined with didactic and pedagogical knowledge of how to use it effectively in learning processes. The DISK approach is a way to combine technical requirements which can be handled with a pedagogical and didactic approach which supports learning and teaching in hybrid scenarios step-by-step. More research has to be done in the field of improving the digital competences of teachers. With regard to the DISK-Online approach additional scenarios can be tested and implemented.

REFERENCES

3PLearning (2020). *5 Challenges of Online Teaching (and How to Rise Above Them).* Retrieved from: https://www.3plearning.com/blog/5-common-pitfalls-distance-teaching-avoid/, access date: 18.10.2020

Beutner, M. & Pechuel, R. (2020a). *DISK-ONLINE - Basiskonzept für die Gestaltung von Online-Unterricht mit neuen Medien durch Lehrkräfte an Schulen - Einfache Umsetzungsmöglichkeiten im Rahmen von COVID-19.* Köln / Paderborn: Ingenious Knowledge.

Beutner, M. & Pechuel, R. (2020b). DISK Online Streaming Concept for hybrid learning – Dealing with the challenges of COVID-19 in learning settings. *Proceedings of Innovate Learning Summit 2020 Online. USA 2020.* Currently in Print.

Beutner, M. & Pechuel, R. (2020c). The use of streaming for online lessons – A basic implementation option in the context of the COVID-19 situation. *Proceedings of SITE Interactive Online 2020.* Currently in Print.

Mehdipour, Y. & Zerehkafi, H (2013). Mobile Learning for Education: Benefits and Challenges. *In International Journal of Computational Engineering Research.* Vol. 3, No. 6, pp. 93-100.

Maniar, N., Bennett, E., Hand, S. & Allan, G. (2008). The effect of mobile phone screen size on video based learning. *In Journal of Software.* Vol. 3, No. 4, pp. 51-61.

Statista (2020): *Anteil der befragten Kinder und Jugendlichen, die zumindest gelegentlich das Internet nutzen, nach Altersgruppen in Deutschland in ausgewählten Jahren von 2014 bis 2019.* Retrieved from: https://de.statista.com/statistik/daten/studie/298170/umfrage/internetnutzung-von-kindern-und-jugendlichen-in-deutschland/, Access date: 18.10.2020