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Personalized Learning and Autonomy

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Abstract: In smart classrooms intelligent systems are embedded in the learning environment. The implementation of these systems is widely accepted to introduce a more personalized learning experience, but the educational context has yet not been fully scrutinized. The examined approaches fail to capture the complexity of the learning experience and underdetermine the pedagogical aspect. Therefore, directions are indicated and discussed to clarify the educational context of technological implementations.

1. Introduction

Big data and artificial intelligence have arrived in almost every aspect of our lives. That they enter the field of education was therefore only a matter of time. In general, the hope is that they can help to build a personalized learning experience and by doing that maybe also lead to a fairer education that can help in particular the learners with difficulties. In response to this situation different applications and devices have been developed: from chatbots that answer questions of students to virtual reality headsets to sensors that monitor the learners and their movements, thus, technology is embedded into the environment of the learner. This is sometimes called “smart classroom”. While there are therefore many ways to implement technological devices into the learning experience, the type of application depends also on the subject, in which they are implemented. Natural Language Processing (NLP) is for example often used to help to acquire foreign languages. And furthermore, it must be considered, which level of education should mainly be taken into account or should even the professional training of surgeons [1] or pilots be incorporated, because also in the professional training intelligent systems are used. There are therefore manifold uses and fields of applications of technological devices in the field of education, which requires consequently a certain limitation. Here, the approaches are discussed regarding educational theories.

The personalization of learning goes hand in hand with learning theories that advocate to design or construct the learning environment to enable the students to learn under the guidance of the teacher and develop their learning progress more autonomously. This is a shift from behavioristic or instructional theories of learning to a constructivism. Although information about the learner has always been collected (exams, projects, participation, etc.), personalized learning through the

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collection of big amounts of data or even the implementations of sensors to monitor the learner, does not only pose a threat to privacy, but also to the autonomy of the learners.

One problem is that with the large accumulation of data it is possible to create a profile of the users and their preferences. For the users it is opaque, which data is used, when they are tracked and on which basis the recommendations and predictions are made. Another problem is that technological systems reduce irritations, which results in the disappearance of clear human-system interfaces: "The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it." [2] So, that the users do not have any obstacles that they need to overcome. A service might be only one click away. But the experience of resistance and failure is essential for forming competences [3], like critical thinking. Consequently, a different form of human-system interaction must be introduced that not only considers the privacy of the student but establishes also how competences can be formed. The main question is: Could there be an AI-based technology that personalizes learning and at the same time facilitates the autonomy of the learner instead of diminishing it? This tension has yet not been dealt with sufficiently in the current state of research, because they focus on the implementation of the technological devices and not the educational background. The general objective of the paper is thus to review the literature with regard to this background and to develop the conceptual forms to demonstrate how the learner can be enabled to acquire competences within a technologically constructed environment.

2. Literature Review

Despite the vast variety of applications, devices and software that are used to transform and personalize learning, most can be grouped around two main forms, at least for the purpose of this paper: (a.) Some approaches suggest monitoring the students with the intention to increase engagement and the attention span and (b.) other approaches focus on correcting mistakes that the students made. Both forms stem from a behavioristic framework, which will be discussed later.

- (a.) Robots, that are programmed to react to the gaze of students, have been used successfully to increase the attention span of the students. [4] Another example is to collect data from the movement of the mouse and keyboard of the students to use this input to evaluate the attention and engagement of the student. [5] Also, the monitoring of the students via cameras to "keep" control over the whole classroom is an idea that was presented [4] and has been realized via facial recognition. [6] Approaches in designing and implementing smart classrooms also mostly focus on monitoring the students. [7], [8], [9]
- (b.) In NLP systems have been developed that are based on syntactical analysis to correct writing errors (for an overview see [10]). For automated evaluation of writings see [11] or [12].[1] Of course, feedback is also crucial to keep the students engaged as is shown in [13].

These two options limit to a certain degree the privacy and autonomy of the learner, thus other kinds of implementations must be used that offer a learning experience that comes closer to the student-teacher-relation. Chatbots e.g., might offer such a learning experience. For an overview over different approaches see [14].

3. Justice and Fairness

According to the report "PISA 2018 and the EU": "Education systems can pursue excellence and equity at the same time. Overall, countries with small proportions of underachievers tend to have also

[1] The examples are taken from NLP, but of course there are many more. Just to mention one idea: one could track the movement of the students playing a musical instrument to detect if they play accurately the instrument and give feedback when they make mistakes. [4]

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high proportions of top performers." But socio-economic and migrant backgrounds affect the academic performance of the students. [15] Consequently, personal, and social circumstances are major obstacles for the development of the potential of the student in the field of education and hint to a "deficiency of fairness". One recommendation is the use of data systems to identify the factors that impair the learning process as well a balance of learner-orientated and objective-orientated educational plans and evaluation methods. The recommendations are manifold to improve the problematic situation of underachievement of students. [16] This deficiency of social fairness is pressing, because "[u]nderachievers in PISA are those pupils who fail to reach the minimum proficiency level necessary to participate successfully in society." [15] However, technological devices or applications are not mentioned as a proficient means to overcome the deficiency of social fairness.

We all would agree that the application of artificial intelligence or intelligent systems must be fair. But what does fair mean? That is very difficult to answer. Even though it is a value that we all presumably share, the criteria or indicators to apply it, are often in conflict: it is fair not to favor certain groups, by discriminating others (treat everyone equally), but also affirmative action policies are considered as fair, even though they favor some groups. Of course, we would agree that artificial intelligence applications should not discriminate someone, for example, by physical characteristics such as skin color or other characteristics like gender, ethnicity, age, nationality, etc. We might also assume that no one most likely designed an application to intentionally discriminate others, more that it was a side consequence that was not intended, e.g., it may have been that in the process of collecting, selecting, and annotating the dataset, it was one-sided, or it discriminates a group with certain characteristics (place of living), and this characteristic is somehow connected with one of the above-mentioned characteristics. Also, legal issues might arise how one can access the dataset and "fix" the model without violating any rights. So, the practical resolution is here already tricky, but might get even more problematic, if we include conflicting criteria of applying the value fairness (justice): treating everyone equal vs. affirmative action.

One intention of introducing personalized learning is to make education fairer. Usually, justice and fairness are discussed either from an egalitarian point of view or as a matter of moral desert. Should we give everyone the same or some more because they need more or because they deserve more? Those are lines of discussions that must be reconstructed for the field of education and under the light of technological implementations to first and foremost evaluate their adequacy. Consequently, under which criteria can fairness be applied if we consider learner-oriented education that must be balanced out with an objective-oriented education. It seems at least that this balance can lead to a fair and personalized learning experience.

Learning-objectives formulate standards for measuring the performance of the student qualitatively and quantitatively. For the learner-orientated education one needs certain data and monitoring of the students to understand their specific needs. The two different forms that were mentioned in the literature review suggest two different approaches that comply with the two criteria for a fair learning experience: monitoring the student and adapt the learning experience to the needs of the student and the correction of the student with regard to certain standards of correctness and furthermore learning-objectives. So, it seems that it might be possible to implement a personalized and fair learning experience if both approaches could be balanced, but this overlooks that both forms remain in a behavioristic framework.

4. Discussion

Technology has the tendency to lessen irritations and to make certain options of action or strategies directly available to us. Even though this can also have a relieving function [3], because technology can free us from other tasks, learning is in fact based on the experiences of irritation, resistance, and

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failure to build competences and abilities. The challenge is then to build learning environments that include irritations and experiences of resistance. This must be elaborated conceptually to connect the philosophy of technology with education.

Consequently, embedding facial recognition and other forms of monitoring into a smart classroom will result in the disappearance of a clear human-system interface and in the problematic point that the students cannot know, which data of them is tracked and used to train or build the intelligent system and in the end to help them. Another consequence of the technological implementations is that it is based on a behavioristic approach to learning through positive or negative reinforcement.

Reinforcement, be it negative or positive, is according to B.F. Skinner not a punishment, which has the goal to get rid of a certain behavior. Reinforcement is obtained through the production of an environment that triggers a certain behavior. The control is according to Skinner "hidden" and it only leads to a subjective feeling of freedom. [17] Behavioristic theories therefore do not have to deal with the so-called "Kantian paradox" [18] or the "pedagogical paradox" [19], i.e., how the learner can acquire autonomy under the guidance of a teacher. In a behavioristic setting the teacher only controls or regulates the performances of the learners but does not have to be concerned with the autonomy of the learner.

A third consequence is that mostly performances are evaluated and not competences. Both function similar: an intended objective is compared with the realized result. (For this distinction in the philosophy of technology see [3].) In the case of a performance, it can be to express an intention in a foreign language, e.g., to order in a restaurant. The intention is realized correctly when the sentence(s) is (are) syntactically and semantically well-formed. That the intention is also understood by another person, is the pragmatical dimension of speech and even more important. (Note, also syntactically and semantically not well-formed sentences can be understood by someone else.) Another performance is the correct calculation of a mathematical problem. Even if the solution of the mathematical problem or performances to express a sentence can be broken down into various steps, the correction of each step can be yielded by positive or negative reinforcement.

5. Conclusion

The acquirement of competences is also based on the difference of an intended objective and a realized result. To acquire the competence of critical thinking or painting many performances must be composed together. The evidence or realized result is a painting or a critical essay. If a student has a certain picture in her "head" or "mind", then she can compare it with the realized result. The difference lies in the manifold techniques that the student must acquire to be enabled to paint in a certain way. A good teacher can break down the process and understand which techniques have not been trained well enough or are missing. The same applies for the case of a critical essay. The teacher might see that the essay is one-sided or that there is the discussion of academic literature missing. This could be improved by introducing an activity like a commented bibliography before the essay is elaborated. The acquirement of competences presupposes therefore the decomposition of the competence in techniques and learning sequences and these techniques in performances. The implementation of technological systems can help in certain parts of the learning experience, but to improve the attention span and an instant "feedback" does not free us from analyzing the learning experience and what should be the result of education.

For this task the conceptual framework has to be established for a form of personalized learning that is aligned with constructivist theories of learning and that enables the students to acquire competences without diminishing their autonomy. This conceptual framework can then be used to design human-system interfaces in the educational context and build learning environments that are more just, make the action environment more transparent and facilitate autonomous learning.

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