

Educational Chatbot with Learning Avatar for Personalization

Emergent Research Forum (ERF)

Gergana Vladova

University of Potsdam
Weizenbaum-Institute, Berlin
gvladova@lswi.de

Leo Sylvio Rüdian

Humboldt University, Berlin
Weizenbaum-Institute, Berlin
ruediasy@hu-berlin.de

Jennifer Haase

University of Potsdam
jhaase@lswi.de

Niels Pinkwart

Humboldt University, Berlin
Weizenbaum-Institute, Berlin
niels.pinkwart@hu-berlin.de

Abstract

The personalization of online courses is an increasing trend in the educational community. One challenge is to collect necessary personal information. Our proposed solution is a chatbot that acts as a teacher with natural language. In contrast to an online course, a chatbot is more flexible and helps to avoid the problems of the usual detailed questionnaire procedure. In addition, an informal way of obtaining this information through the chat addresses other psychological and behavioural issues such as acceptance and is a suitable alternative that can be expanded at any time during the use of the system. Finally, our approach to using a chat allows us to collect more personal information that can be used for educational recommender systems. We present the current state of our research and discuss two possible scenarios in the context of creativity to demonstrate the benefits for the learner.

Keywords

Online courses, learning, avatar, creativity, chatbot, personalisation

Introduction

Individual learner differences like personality or cognitive engagement influence the learning behavior. More effective tutoring in an online environment can be achieved by applying a cognitive model for each participant that can be used to predict his behavior and performance (Chaplot et al. 2018). One deficiency is the difficulty to raise personal data for personalization. Online courses mostly have access to demographic data only. However, there are other items that have even more impact on the behavior. Our solution is a system that uses an educational chatbot with which participants interact in context of the online course. Since chatbot technology can be used for learning and teaching as well (Kiptonui 2013), we use this method to offer learners a dialogue based-system that teaches in a personalized way. Our chatbot is connected with a database, which collects, stores and updates personal information during informal chats and data from previous learning processes. This is then aggregated in what we named “Learning Avatar”, which has the ability to create a cognitive model of the user based on collected additional user- specific data. Its use helps to personalize further learning. For the purpose of collecting data used for personalization, participants in a regular online course must complete a questionnaire with many non-contextual questions that have nothing to do with learner-related questions. In view of the creation of an informal and trusting atmosphere between learners and the system as a communication goal and context, we use the general ideas of Eliza (Weizenbaum 1966) and current conceptions of educational chatbots that are the stage of the art (e.g. Le, Masche & Pinkwart 2011; Serban et al 2017; Fryer 2019). Our main research questions are:

1. How exactly should a dialogue system be designed to capture the described participant’s data and to “translate” them into the Avatar figure?
2. What are the advantages for the learner of using the Avatar figure within the learning process?

In the following, we will first explain our methodology for creating the Avatar and answer the first research question. After this, we will discuss the second research question using the example of aspects of creativity.

Methodology

We use a chatbot as an interface and users interact with the system by using natural language. The advantage of the chatbot as an interface lies in the possibility of switching between learning and informal talks, in the concrete context of our Learning Avatar, defined as the set of data that represents the user’s learning knowledge combined with additional data that can be used for personalization (s. Figure 1).

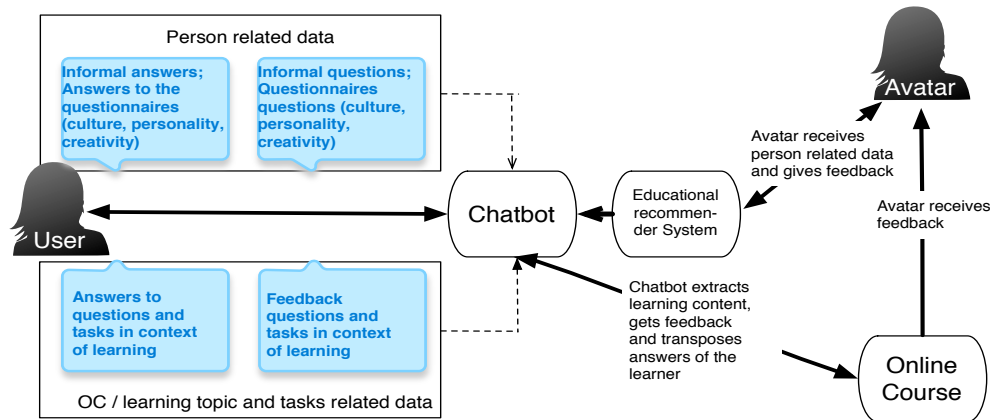


Figure 1. Framework to use a chatbot with a “Learning Avatar” and online courses

The chatbot is connected with the Avatar and with a online course (OC), which contains required learning materials whereby are performed fluently in a continuous process of creating and optimizing the Avatar:

1) Collecting features through dialogs with the chatbot. Depending on our goals, the focus is on different aspects that have been identified as influencing factors on the learning process and results. Examples are sociodemographic data (gender, age, country of living), personality traits (e.g. Big Five (Barrick & Mount 1991)), individual cultural information (e.g. Hofstede 2011), aspects of creative personality (e.g. Feist 2010). These studies include validated questionnaires that allow personal characteristics of the individual to be identified. There are different ways to imagine the actual interaction between the chatbot and the user and thus different time points to ask the relevant questions. Upon the first use, general and not (very) dynamic characteristics of the person (demographic data, personality traits, culture) should be addressed. However, some learning courses may require specific features that are necessary for best performance. These functions are best collected between exercises. In addition, the chatbot can be used to ask questions about the learner’s self-perception after completing a test. An example would be the Avatars’s requirement to give the learner a medium complex task. This requirement is met by the chatbot by accessing the online course content. However, it is still important to know whether the task has been perceived as just as complex by the learner as predicted based on personality traits, in order to constantly adjust and optimize the Avatar. For this purpose, the chatbot can ask control questions in an informal conversation. These dialogues can also be extended by motivating, intervening and helpful aspects. In our view, this is the most important task and is supported by the development of specific guidelines for different learning situations. At this point, we want to use and apply pedagogical and psychological concepts, especially in the field of online gaming. The aim is to give the learner the opportunity to consciously co-design the avatar. **2) Building a Learning Avatar.** The Avatar represents the learner’s knowledge and characteristics, including socio-demographic data, personality, cognitive model, existing

learning relevant mental models and culture. Updating of the avatar happens every time the user interacts with the chatbot. **3) Teaching the user by providing information extracted from the online course.** This information can be text-based, image-based or in the form of videos such as those created as part of the online course. The course does not differ in any way from a normal learning course. **4) Reviewing user's knowledge** Participants have to answer questions about content they have already learnt. Control or other informal questions of the chatbot can also be positioned within the review task. **5) Analyzing the learning success of users.** In this step, the results of the online course are evaluated by querying the learner's knowledge. **6) Intervening, motivating and helping the user.** This step is performed during the learning process to optimize the learning outcome. This is part of the interaction with the chatbot that could be turned on during the course.

In the next section we show the role the avatar can play for the learner using creativity as an example. We have chosen this example against the background of the importance of new learning methods, problem-based learning and thus new learning methods, especially in the context of digitalization (e.g. Kop and Carroll 2011; Seng 2000). Creativity plays a very important role in the development of learning potentials and supports the application of different learning styles (Fisher and Williams 2004).

The “creative” Avatar

The need for the generation of creative and innovative solutions is without question in our everyday lives (Tamannaieifer and Motaghedifard 2014), but also for companies and on a societal level (Mumford et al 2012). Thus, a training of creative skills is of utmost interest. The Avatar entails benefits concerning the teaching and enhancement of creativity, which are twofold: by enhancing creativity-relevant processes (e.g. Guegan et al 2016) creative performance associated personality traits, as well as the basic cognitive ability of thinking abroad.

Creativity is a complex construct, which entails multiple functions like the creative person, process, product and press (Rhodes 1961). Since we aim to improve personal skills and knowledge, the focus within the broad creativity concept lies within the creative person. Here, the extent whether a person is more or less creative is determined by a complex interplay of the person's cognitive traits (like openness to experiences, cognitive flexibility), social traits (like nonconformity, independence, self-confidence), motivational and affective traits (like drive, persistence, intrinsic motivation), as well as clinical traits (like low latent inhibition, schizotypy) (Feist 2010). There are several elements which can be more easily shaped and influenced from the outside and thus are predestined to be included in online curricula. Especially some aspects of the social and motivational traits can be shaped by feedback about the actual creative performance (Byron & Khazanchi 2012). A person's creative self-efficacy beliefs (CSE) determines the person's conviction about the own creative abilities and thus has an impact on the intrinsic motivation towards solving creative problems and their actual creative performance (Prabhu 2008). Thus, a person will be more motivated to behave in a creative manner and confront themselves with creative tasks when their inner belief system is optimistic towards creativity (Meinel et al 2018). The overall goal by using the Avatar is the creation of a coherent, slightly positive self-image concerning a person's creative abilities to get them motivated to behave creatively. With the help of the Avatar, the creative performance can be trained and improved addressing all stages of the process: first, the belief system concerning own creative abilities can be assessed, second, fitting and challenging creative tasks can be presented and third, based on the performance on such creative tasks, the persons abilities can be praised so the person achieves an overall more positive CSE. Also, a too optimistic but unrealistic self-perception, usually found in persons who lack the chance of feedback on their creative performance, or even the whole performance, can be corrected smoothly by a conversation with the chatbot (Pretz et al 2014). In comparison with an objective feedback on the performance from the online course directly, the chatbot can integrate the person's self-perception of creativity and adjust the feedback based on that (making the feedback less objective but most likely more effective). CSE can be assessed (during the chat-session) with the help of a three-item scale (Tierney and Farmer 2002) and creative tasks are used and evaluated plentiful in the literature (e.g. Michalko 2010). Here, in comparison with a traditional class-room learning scenario, the Avatar can better equip the person with concrete and detailed feedback on his or her performance via the chatbot and from time to time assess the progress of the persons CSE.

Since the aforementioned approach is relative broad and addresses the creativity construct more indirectly, another scenario is plausible to use the Avatar in the context of creativity. During a conversation with the chatbot, cognitive traits concerning creativity can be trained and assessed directly. Cognitive flexibility, the underlying basic cognitive function of creativity is most prominently operationalized by divergent thinking. It basically describes the ability to associate broadly and find connections between unfamiliar contexts (Runco & Acar, 2012). There are many techniques how one can improve this ability, which can be implemented into the conversation of the Avatar. For example, the “Walt Disney Method” can be presented and developed by using a real-life problem (Dilts, Epstein and Dilts 1991). Since we are not used to only apply one certain thinking style, the Avatar can help with focusing on the view and also to fully immerse by asking suitable questions. Thus, the person learns and trains a method to be more creative when solving everyday problems. Plus, by getting appropriate feedback on the performance, the CSE will also be shaped and nurtured.

Limitations and further research

By nature, a chat is like a log file of the entire discussion. If a user needs to remember knowledge (Bloom 1956), he can look directly at previous messages to find correct answers, which is not useful in the learning process. We solve this problem by hiding information that contains the answer to the question until the user has given it. When we use a chatbot as an interface, the clickstream of a learning environment contains less data. Clickstream data such as the display of info-boxes, mouse pointer movements, or time to answer a question is not enough because the chatbot is a new layer that provides visible information about the given online course. After all, the online course itself cannot track all the information as before. This can lead to poorer feedback from the online courses themselves. Furthermore, by providing informal questions, participants can also provide incorrect information, which can lead to incorrect development of the Learning Avatar.

Although both proven questionnaires and theories can be used to capture the personality, culture, creativity of the user, the question remains how to “translate” the complex elements into those that allow the creation of the Avatar, and the user's answers into a coherent, manageable, meaningful and relevant learning model. Conceptually, this is one of the most difficult questions. Questions of usability also arise. Setting up the natural informal communication situation between the user and the chatbot is a big challenge. A critical task is to ensure that the learner is not annoyed by the interruption and to evaluate that the chat interaction is not viewed as annoying as a questionnaire.

A very important topic are the data protection concepts in the development of the avatar. At this point, we see individual, often culturally determined differences in the perception of risks and opportunities in the collection of personal data. At the moment, our approach is to see the learner as the owner of the data and the decision maker in relation to its use. Our home institution and we, as part of a broad interdisciplinary research team, are currently working on issues that allow us to research ethically and to act conscientiously with regard to the collection and use of personal data. The Avatar is a research project dealing with technical, psychological, pedagogical, educational, legal and ethical aspects.

Our project is still at the beginning. Our Avatar is for the moment only planed as a kind of “mental model” tailor-made according to the person and hidden in the background of the chatbot. Further research aspects include for example aspects as a design of the chatbot interface, possibilities of direct communication between the chatbot and the Avatar, and, in this context, the design of the Avatar and the possibilities to make it visible and customizable by the user.

Acknowledgements

This work was supported by the German Federal Ministry of Education and Research (BMBF), grant number 16DII116 (Weizenbaum-Institute). The responsibility for the content of this publication remains with the authors.

REFERENCES

- Barrick, M. R., and Mount, M. K. 1991. "The Big Five Personality Dimensions and Job Performance: A Meta-Analysis". *Personnel Psychology*.(4:1), pp. 1-26.
- Bloom, Benjamin S. 1956. *Taxonomy of educational objectives. Vol. 1: Cognitive domain*. New York: McKay, pp. 20-24.
- Byron, K., and Khazanchi, S. 2012. "Rewards and creative performance: A meta-analytic test of theoretically derived hypotheses". *Psychological Bulletin*, (138:4), pp. 809–830.
- Chaplot, D. S., MacLellan, C., Salakhutdinov, R., and Koedinger, K. 2018. "Learning Cognitive Models Using Neural Networks." Pittsburgh: AIED.
- Dilts, R., Epstein T., and Dilts, R. W. 1991. "Tools for dreamers: Strategies for creativity and the structure of innovation". Meta Publications.
- Feist, G. 2010. "The function of personality in creativity" in The Cambridge Handbook of Creativity, J. C. Kaufman & R. J. Sternberg (eds.), Cambridge: Cambridge University Press, pp. 113-130.
- Fisher, R., and Williams, M. (Eds.). (2004). *Unlocking creativity: Teaching across the curriculum*. Routledge.
- Fryer, L. K., Nakao, K., Thompson, A. (online). Chatbot learning partners: Connecting learning experiences, interest and competence. *Computers in Human Behavior*. doi 10.1016/j.chb.2018.12.023
- Guegan, J., Buisine, S., Mantelet, F., Maranzana, N., and Segonds, F. 2016. "Avatar-mediated creativity: When embodying inventors makes engineers more creative". *Computers in Human Behavior*, 61, 165-175.
- Hofstede, G. 2011. "Dimensionalizing Cultures: The Hofstede Model in Context". Online readings in psychology and culture, (2:1), p.8.
- Kiptonui, B. P. 2013. "Chatbot technology: A possible means of unlocking student potential to learn". *International Research Journals* (4:2), pp. 218-221.
- Kop, R., and Carroll, F. 2011. Cloud computing and creativity: Learning on a massive open online course. *European Journal of Open, Distance and E-learning*, 14(2).
- Le, N.-T., Masche, J., and Pinkwart, N. 2011. ELIZA – The Historical Development of Conversational Software: Classification, Technology and Application Domains. *In Hello, I'm Eliza. Vol. 4*
- Meinel, M., Wagner, T. F., Baccarella, C. V. and Voigt, K.-I. 2018. "Exploring the Effects of Creativity Training on Creative Performance and Creative Self-Efficacy: Evidence from a Longitudinal Study," *The Journal of Creative Behavior*.
- Michalko, M. 2010. "Thinkertoys: A handbook of creative-thinking techniques". Toronto: Ten Speed Press.
- Mumford, M. D. 2011. "Handbook of Organizational Creativity". Academic Press.
- Prabhu, V., Sutton, C., and Sauser, W. 2008. "Creativity and certain personality traits: Understanding the mediating effect of intrinsic motivation." *Creativity Research Journal* (20:1), pp. 53-66.
- Pretz, J. E., and McCollum, V. A. 2014. "Self-perceptions of creativity do not always reflect actual creative performance," *Psychology of Aesthetics, Creativity, and the Arts*, vol. 8, no. 2, pp. 227–236.
- Runco, M. A. and Acar, S. 2012. "Divergent Thinking as an Indicator of Creative Potential," *Creativity Research Journal*, vol. 24, no. 1, pp.
- Rhodes, M. 1961. "An analysis of creativity". *The Phi Delta Kappan* (42:7), pp. 305–310.
- Serban, I. V., Sankar, C., Germain, M., Zhang, S., Lin, Z., Subramanian, S., ... & Rajeshwar, S. 2017. A deep reinforcement learning chatbot. arXiv preprint arXiv:1709.02349.
- Seng, T. O. (2000). *Thinking skills, creativity, and problem-based learning*. Temasek Polytechnic Singapore.
- Tamannaefar, M. R., & Motaghedifard, M. 2014. "Subjective well-being and its sub-scales among students: The study of role of creativity and self-efficacy". *Thinking Skills and Creativity*, 12, 37–42. <https://doi.org/10.1016/j.tsc.2013.12.003>
- Tierney, P., and Farmer, S. M. 2002. "Creative self-efficacy: Its potential antecedents and relationship to creative performance." *Academy of Management Journal* (45:6), pp. 1137-1148.
- Weizenbaum, J. 1966. "ELIZA – A Computer Program For the Study of Natural Language Communication Between Man And Machine". *Communications of the ACM* (9:1), pp. 36-45.