Maximizing Authentic Learning and Real-World Problem-solving in Health Curricula Through Psychological Fidelity in a Game-Like Intervention
Development, Feasibility, and Pilot Studies

Kuipers, Derek A.; Terlouw, Gijs; Wartena, Bard; Prins, Jelle T.; Pierie, Jean Pierrre E.N.

DOI
10.1007/s40670-018-00670-5

Publication date
2019

Document Version
Accepted author manuscript

Published in
Medical Science Educator

Medical Science Educator

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--Manuscript Draft--

Manuscript Number:	MDSE-D-18-00125
Full Title:	Maximizing Authentic Learning and Real-world Problem Solving in Health Curricula through Psychological Fidelity in a Game-like intervention: Development, Feasibility and Pilot Studies
Article Type:	Original research
Funding Information:	
Abstract:	High fidelity is regarded as the hallmark of educational games and simulators for health. In this uptake, mostly physical and functional fidelity are associated with authenticity, resulting in a pursuit of real-to-life simulation. This recognition has given rise to an almost generally accepted and often unconscious design rationale that assumes that the more a game or simulation mimics the real world, the more authentic the intervention is expected to be. Psychological fidelity receives significantly less attention, while we know that this is strongly related to credibility, suspension of disbelief and engagement. The BABLR artifact reduces physical and functional fidelity to a minimum and explores the use of psychological fidelity as the main carrier of an authentic learning experience. BABLR is tested with a total of 26 participants with varying backgrounds in health innovation and social work. In several pilot studies we collected data on perceived realisticness and real-world relevance. Results show that experts as well as participants acknowledge BABLR for its engagement, immersiveness and motivational qualities. The scores on perceived realisticness of the scenarios and expected learning outcomes are promising. Practical implications of these findings for future research into developing low-fidelity simulations with high psychological fidelity will be discussed.
Corresponding Author:	Derek Albert Kuipers, MSc. NHL Stenden University of Applied Sciences Leeuwarden, Friesland NETHERLANDS
Corresponding Author Secondary Information:	
Corresponding Author's Institution:	NHL Stenden University of Applied Sciences
Corresponding Author's Secondary Institution:	
First Author:	Derek Albert Kuipers, MSc.
First Author Secondary Information:	
Order of Authors:	Derek Albert Kuipers, MSc.
	Gijs Terlouw
	Bard Ole Wartena
	Jelle T Prins
	Jean Pierre E.N. Pierie
Order of Authors Secondary Information:	
Author Comments:	

Abstract

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1 Introduction

A growing interest in game-like interventions as a means to educate and train people becomes apparent in the amount of serious games and simulations that are used in the field of health and medicine (Durkin 2010). In literature there is an increase in studies evaluating game-like interventions that are developed and used explicitly for health education and training. Still, the use of games for medical education is in its infancy, and the full potential of serious game applications in this area has to be explored further (Kato 2010). As is customary in the field of pharmaceutical therapies, games are held to the same rigorous scientific standards in randomized trials (Kato et al. 2008), but the design rationale of game-like artifacts is rarely explored (Fleming et al. 2015). From the point of view of the development of drugs or medical procedures, the quest for effectiveness is necessary and justified. Without diminishing the importance of effect studies, in the case of designing game-like interventions for health education, it is too early to make statements in general terms about what does and does not work. It is necessary to create space for experimenting with different guises of games and simulations. Particularly when it comes to fidelity, there seems to be a limited scope on the appearances of game-like interventions. Studies on game-like interventions for health do not elucidate design choices made and rarely provide design principles. Almost by default, games for health aim to achieve a true-to-life, high fidelity representation (Barry Issenberg et al. 2005).

In this introduction section we discuss the reason for the creation of BABLR and describe supporting theories in the *problem space*. In the *design space*, the emphasis is on how design choices are formulated and how they have shaped the artifact as is. The artifact itself is also briefly described here. Last but not least, in the *solution space* we discuss the preliminary results obtained from the first tests with the prototype thus far.

1.1 Problem Space

The field of health innovation education encompasses socio-technological issues, including technology acceptance, user-centeredness and a learners' mindset towards design science research (Badwan et al. 2017). Attitudes and mindsets are important components of this competencies, especially within health innovation curricula and in so-called 21st century skills (Frenk et al. 2010; Trilling and Fadel 2012) on a broader scale. In traditional health curricula these tacit elements in competencies are hard to teach, train and measure in concrete, literal form (Frank et al. 2010).

It might be useful to elaborate briefly on the reason why design research is needed in health. Current health curricula teach natural or analytical sciences that are appropriate for the study of inductive and deductive phenomena. Design research addresses the relevance gap known to natural sciences research to deal with so-called wicked problems, that require creative and innovative solutions (Hevner and Chatterjee 2010a). Abductive reasoning (Dorst 2011) is needed to deal with unstable requirements and complex interactions that call upon cognitive and social skills in developing and communicating solutions (Hevner et al. 2004). Labelled as the nature of contemporary problems, these abductive challenges are described as being open, complex, dynamic, and networked (Dorst 2015). One could argue that these ingredients are at the core of what is referred to as the fuzzy front-end of design-based challenges (Koen et al. 2001). In these challenges, design research in health becomes of imminent importance. Health curricula should emphasize a designer's mindset amongst students and equip them with skills such as prototyping and concept visualisation to engage problems as design opportunities for innovation (Evans 2011).

The problem-based learning paradigm is well known and adopted in health education (Savery and Duffy 1995; Davis 1999; Taylor and Miflin 2008; Savery 2015). Defined as being "learning that results from the process of working toward the understanding or resolution of a problem" (Barrows and Robyn M. Tamblyn 1980; Savery 2015), it forms a natural fit with the endogenous intent (Fogg 2003) of the BABLR artifact. The reappropriation of problem-based-learning in health curricula produces the "desired habits of mind, behavior and action to become competent, caring, and ethical healthcare professionals" (Gwee 2009). Exposing health students during their education to authentic and ill-defined activities with real world relevance (Herrington et al. 2003) connects problem-based-learning principles to design research.

1.2 Design Principles

The reason for labeling the BABLR artifact as a low-fidelity game-like intervention stems from the ideas surrounding design for transfer (Kuipers et al. 2013) and zero-fidelity (Toups et al. 2011). The elaboration of these principles goes beyond the scope of this article, but form the basic design principles on which the artifact rests. The main idea is that where realisticness is concerned with the degree of similarity with the real world, realism can be seen as perceived realisticness which requires congruence in fidelity types and and resulting artifact acceptance (Galloway 2004). This underpinning theoretical exploration forms the basis for the the design of a low-fidelity game-like intervention for the acquisition of competencies in health innovation curriculum, with sufficient psychological fidelity (Kozlowski et al. 2004) for suspension of disbelief.

1.3 Supporting Theories

A first supporting theory (ST) that informs the design of the artifact is that of double-loop learning (Argyris 2002). In short, the concept of double-loop learning demands for tacit knowledge to become explicit. Initial actions of players arise from their mental models with regard to how to act in presented situations. Double- loop learning occurs when error is detected and corrected in ways that involve the modification of one's underlying norms, beliefs and objectives, rather than just adapting to the situation.

Further substantiation for the artifact is found in the narrative transportation theory (Green et al. 2004). Narrative transportation occurs whenever the player experiences a feeling of entering a world evoked by the narrative because of empathy for the story characters and imagination of the story plot (van Laer et al. 2014). Narrative transportation is held to be more unintentionally affective than intentionally cognitive in nature. To enable double-loop learning, the design of the BABLR artifact must therefore implement dedicated feedback loops that facilitate reflection-in-action, without causing narrative fidelity dissonance (Kuipers et al. 2013).

In early simulations, psychological fidelity was considered as a byproduct of high fidelity (Hays and Singer 1989). This way of thinking implies that low fidelity does not have any psychological value, although there are also studies that argue for low fidelity simulations, provided that they maintain a direct connection with real world tasks (Kozlowski et al. 2004). In research, to some extent the degree of realism is held to be conditional for transfer to occur.

Fidelity is believed to be of importance in terms of relevance for learning and transfer (Berman and Macpherson 1999)(Noble 2002 Jan 1), denoting the degree of similarity between the training situation and the operational situation, which is simulated (Hays and Singer 1989). However, literature also describes other forms of transfer, in which learning does not necessarily occurs following a literal path (Salomon and Perkins 1989) (Royer 1979). According to Alexander (Alexander et al. 2005) fidelity has dimensions beyond the visual design of a game. Notions of simulation fidelity include physical, functional and psychological fidelity (Alexander et al. 2005; Lukosch et al. 2013).

Our previous research (Kuipers et al. 2017) on second class of transfer (Royer 1979) types showed that low fidelity is rarely consciously applied as a design motive for the development of game-like interventions for health education and is usually associated with physical or functional fidelity alone. Cost saving is by far the most common reason to choose low fidelity over high fidelity. Where we found low fidelity as a conscious basis for the design, the objective always was the reduction of cognitive load (Sweller 1994) or the assumption that reduced fidelity is sufficient for learning motor and spatial skills. One study coined the concept of zero fidelity in a game without concrete elements of the simulated environment (Toups et al. 2011), and is consequently almost the only study of a game-like artifact where a substantive reason is put forward in favour of the use of low fidelity.

If we ignore the transfer requirement, there are certainly examples of research into game-like artifacts that deliberately bring physical and functional fidelity back to the minimum, especially in the field of employee selection (Motowidlo et al. 1990). As mentioned earlier, *Psychological fidelity* is an important design parameter in serious games and simulations (Toups et al. 2011; Gopher et al. 1994; Salas et al. 2005; Rooney 2012; Dankbaar et al. 2015). In addition, these studies all claim that representing the real world as literal as possible is less important for learning. The definition of psychological fidelity in this studies varies slightly, e.g. cognitive fidelity (Hochmitz and Yuviler-Gavish 2011), but all studies mention the abstraction of certain real world concepts and a process of recontextualisation. *Suspension of disbelief* as an important characteristic of psychological fidelity: oneself's temporarily allowance to believe something that is not true-to-life. Despite the second class of transfer is not explicitly stated in those studies, they implicitly confirm the second class of transfer as a promising concept in serious game design for learning. When it comes to acquiring attitude and mindset aspects of health curricula competences, there seems to be a natural fit with the second class of transfer.

1.4 Working Theory

The working theory is in fact all the above theories captured in one design hypothesis, bridging the problem space with the design space, laying out the contours of the prototype. The design hypothesis here states that the artifact to be designed should contribute to the acquisition and explicitation of attitudes and mindsets belonging to a new generation of innovative health professionals. The artifact can achieve this by a text-driven scenario-driven simulation game, which with minimal means evokes a real-to-life world, which provokes the player to perform meaningful actions.

2 Methods

The research and development of the BABLR artifact is structured around *spaces* laid out in the *layers in serious media design model (LiSMD)*, depicted in the left side of Figure 1. Common to design research practice, the prototypical instance of the artifact itself is regarded as an emergent boundary object (Carlile 2002), endeavoring towards a befitting answer to the problem-solution binary. In this uptake, the *design space* connects the *problem space* to the *solution space* and serves as the method for our research. This process of appropriation is facilitated by a design science research approach (Hevner and Chatterjee 2010b), as our primary objective is to develop a game-like artifact, as shown on the right half of Figure 1. Accordingly, the research approach involves (1) the definition of the problem and the objectives of the artifact, (2) the design and development of the artifact, and (3) the evaluation of the artifact as a *design-in-the large* (Klabbers 2003).

[Figure 1 near here]

2.1 Design Space

Within the *design space* we adopted a design science research approach (Hevner and Chatterjee 2010b) for articulating the design choices for building the BABLR artifact. The right side of Figure 1 depicts the design research procedure that we followed. This framework (Kuipers et al. 2016) is adapted from the rapid prototyping ISD model (Tripp and Bichelmeyer 1990) and facilitates the development of the BABLR artifact through an iterative-incremental process. The focus of these iterations shifted during the process along to non-linear design steps (Warner and Simon 1969), including ideation, prototype development and prototype testing.

The first phase involved the development of the LiSMD-model (left side of Figure 1). The initial version of the model was constructed through a synthesis of various concepts and best practices aligned with main findings from DPs and STs as mentioned in Sections 1.2 and 1.3. Face validity was ensured through peer-review and expert feedback sessions to refine and finalize the model.

2.2 Procedure and Participants

Expert Panel

Before playtesting BABLR, the scenarios were presented to five field experts. The experts were selected on the basis of a variety of expertise, such as specific knowledge about the practice of health and social work, knowledge about serious games and simulations and knowledge about education in the field of healthcare. For each session, BABLR uses a scenario tailored to the target group, each with its own internal trajectory and objectives. The experts reacted in particular to these scenarios, because it is precisely here that the functioning of BABLR becomes tangible. During the panel sessions, the scenarios and corresponding characters were presented in a walkthrough of the storyline. The experts were then invited to share their initial reactions and findings on the scenario in question. A final, semi-structured questionnaire asked the field experts about their reactions to, respectively, the perceived realisticness of the scenarios, the expected learning effect and engagement.

Pilot 1

A first 8 day-pilot in which six students participated from the bachelor of social work, all attending an *eSocialwork* specialization course. Afterwards all participants were invited to partake in an evaluation session. A questionnaire was used to ask the players about the perceived realisticness of the scenarios, the expected learning effect and engagement. Conditional for participating in the evaluation was a minimum of 2 interactions every 24 hours. All participants were rewarded with a cinema voucher. In addition to the participants' gaming experience, the aim of this pilot project was also to verify the overall system performance, to test playability and the lead time of the scenario.

Pilot 2

Ten bachelor students from different study programmes at the NHL Stenden University of Applied Sciences participated in the second pilot. A shortened scenario concerning communication styles had been developed for this pilot in order to introduce students to BABLR. For one week the students played the role of a junior communications officer, who just started a new job. During the game, however, the various contacts with the virtual opponents showed that there was a lot going on within the communication agency. During a joint debrief, the experiences were discussed and shared.

Pilot 3

During the third pilot project, nine social work professionals played a dedicated BABLR scenario for four weeks. These professionals were employees of the Tinten Welfare Group, a large social work organisation (550 employees), located in the North-East of the Netherlands. The participants were part of a district team in the city of Emmen, and had different specialisations within the social domain, such as youth worker, social worker or community worker. The district team participated as a whole in this pilot and was appointed by the Tinten Welfare Group’s head of education. All participants were informed beforehand that the pilot was part of a study. A formative evaluation was conducted after two weeks and an extensive debrief took place at the end of the session. Again, the purpose of the second pilot was to gather information about the perceived realisticness of the scenarios, expected learning effects, and engagement.

In addition to gaining insight in the pilots into *early indicators of success* of the BABLR artifact, each session gave the designers of BABLR new insights into changes to the prototype itself. BABLR's front end is actually nothing more than the respondent's mail client. After some start-up problems (emails sometimes ended up in a junk folder with the respondents), hardly any adjustments were needed. Most of the changes are done to the back-end of the prototype. In particular, the manageability of the various storylines in which individual players can find themselves proved to be a real challenge. Following the experiences with the pilot studies, far-reaching changes have been made to the initial versions of BABLR. The current version of the artifact is presented below as a result of the design research process.

3 Results

3.1 Design Choices

As described in the introduction, BABLR is designed as a low-fidelity simulation game (DC). In order to optimise accessibility, the starting point was to be able to play the simulation without third party software (DC). The player plays the simulation from his or her own mail account. The text-based character of communicating via email makes it possible to establish narrative transportation through scenarios (DC) which pre-selects on psychological fidelity alone. The scenarios are carefully crafted and based on authentic practical situations engaging players in real-to-life affairs (DC). All scenarios are set in the context of health and social work and place the player in a key position of a change agent (DC). In this capacity, the player must solve complex problems in the areas of project management, communication skills and design-based research.

3.2 Artifact

BABLR is designed to provide an authentic experience in a role-playing environment for students. By asking students to take on a role in a virtual project team, the BABLR offers a semi-structured method of exposing players to a wide range of social, political, economic, and scientific conflicts that affect complex engineering projects. A total of 26 players from different disciplinary backgrounds have used this learning tool with tailored scenario's to collaborate with others on authentic problems in the field of health innovation. All scenarios contain elements from project management, personal leadership, uncertainties and resistance in change processes and change agency through design research techniques.

The implemented BABLR scenarios provide complex socio-technological quests that give utterance to authentic decision making, promoting collaboration, technology acceptance and leadership skills, all needed to be successful practitioners in the field of health innovation. The prototype was evaluated in play test sessions with end-users, including an immersion study, again providing input for the design and development of the prototype. After each session, observational data and players feedback was analysed and led to a partial redesign or reconfiguration of the artifact.

Each scenario starts with a short introduction email. It welcomes the player as a new team member, explains the task to be tackled and presents the virtual team members and their job profiles. The scenario unfolds when the player contacts the right virtual team members and commits them to action in an appropriate way. Ideally, a golden path towards the successful play of the simulation should be formed. The number of contact moments needed and the mood state of virtual team members are indicators of the quality of communication and the player competence in making the right choices at the right moments.

The emails with virtual player responses are sent from the BABLR mail client. The game moderators can log in to the backed via a web browser. Players can be added to BABLR, players can be divided into groups and players can be linked to a specific scenario. In addition, the moderators can monitor and influence the course of a scenario from this backend. The content of the reactions of the virtual team members is partly automatically provided by BABLR, but also supplemented by a moderator. This is primarily to ensure that the players experience the highest possible degree of authenticity in the conversations, but also to sometimes lead players back to the golden path in the scenario. The system knows where in the timeline of the scenario the player is situated and, based on that information, predicts the most appropriate response of a virtual character to an email from the player. Moderators will modify and agree to these proposed responses as appropriate. Each player develops a certain understanding with his or her virtual opponents. For example, opponents can be happy or irritated and react from this state of mind. It is up to the player to recognize these emotions and respond accordingly.

Scenarios

The scenario developed for pilot 1, called FOCUS, was about a healthcare institution, for which a digital innovation had to be developed. Whereas the healthcare institution itself seemed to have strong ideas about the artefact to be developed, during the scenario players find out that end-users seem to have totally different wishes. The scenario in pilot 2 was named BABEL, and dealt with misunderstandings within a communication agency. The key to playing this scenario could be found in addressing mutual disputes and applying a communication model provided by a virtual character. The TINTEN scenario used in pilot 3 could be completed by informing each other about an ongoing case as social workers. Coordination resulted in a more complete picture of a social situation. After obtaining this overall picture, it was possible to work towards the end by choosing a collective, coordinated method.

Sphere Display

Another part of the system is the sphere display (Figure 2). On an additional monitor, the BABLR backend displays the individual timelines of a group of players in horizontally distributed vertical lines. A single line represents one player. Coloured spheres are shown on this line from above, corresponding to the interactions. Each virtual character has its own colour. With several successive interactions, the sphere increases in size. The last open mail is shown as a pulsating sphere. This spherical display ensures that moderators have an overview at a glance of the progression of a group of players, where obstacles arise, and where action is needed. The sphere display is the only graphic component of BABLR, but it is not visible for players.

After completion of a scenario, or on the set end date, players and moderators will evaluate and reflect on the course of the simulation, critical incidents and personal experiences in a debriefing session.

[Figure 2 near here]

3.3 Intervention

This paragraph describes the *early indicators of success*, which preface the potential effectiveness of the intervention. In this phase we can state with sufficient certainty that the design decisions underlying the artifact result in a desired outcome. The LiSMD *intervention layer* connects the design space to the solution space. The artefact nears its prototypical completion in terms of demonstrated appropriateness and effect.

Perceived usefulness

Field experts indicated that the concept shows face validity to be effective. In addition, they also underlined the importance of training of an instrument capable of training extracurriculair skills in a safe environment. The ability to evoke real-life learning situations that are difficult to recreate in existing health curricula was identified as a strength of the BABLR concept. After the concept has been submitted to the experts, the following question was asked to give an initial response to the design. During the questioning, the strengths and weaknesses of the artefact were examined until a clear argumentation was given.

Expert 1 was the first to mention that the prototype mainly deals with the relational aspect of such projects. In addition, expert 4 mentions the replayability as a major plus point, as well as "*the ability to travel several routes, make different choices, the feedback mechanisms that ensure that there are consequences for the choices and the ability to gain experience with such projects.*" As a possible weakness, expert 1 mentions that the system or the scenarios can steer too much: "If there is too much steering, it is tricky (...) that really has to be taken into account." Also, expert 3 mentions the lack of actual visual designs to respond to: "I am of course also a designer, I think it would be very nice if students could also respond to visual designs in terms of content (...) you could of course put that into a scenario."

Expert 2 comments: "This is really very recognizable from my practice". The similarities with practice and the degree of realism are regarded as strengths. "I also think that gaining experience is a very strong point, very well done." In addition, expert 2 recognizes the phases of design thinking principles as well as their application within the prototype. Expert 2 sees a possible risk in the construction of the scenario "*because it can quickly become over the top.*" "Of course you try to let the important moments and escalations happen, but that can easily become too much (...) or maybe it becomes too difficult."

Motivation / engagement

Within the expert group the main reaction focuses on the player's experience: "In this simulation you really engage the student in an unique experience within a vivid scenario", and "We [expert 5's association] have realistic-looking simulations and they work well, but as soon as they [students] get out again, it [the experience] is over. That's just for a brief moment, but in this simulation you can really keep them [the players] involved for a longer period of time..." The flexibility of the scenarios and storylines were also mentioned as a strong point. The time-consuming role of the facilitator as part of the simulation was identified as a weakness: "In order to keep it [the simulation experience] realistic, you [the facilitator] have to respond to the content and respond to what the player says. That is good, but it will also take time."

Perceived realisticness

When asked: "Do you expect the students will experience the simulation as realistic and authentic?", all the experts responded affirmative. Expert 1 said: "Yes, very realistic. On several levels, both social and in terms of routes, there are many possibilities." Expert 3 added: "Yes, this is very realistic. Also in the scenario, the persons [virtual characters] are very recognizable and also their behaviour is very true to life (...) a behavioural therapist [virtual character] who is critical, yes, I experienced that so often myself." In addition, the expert 4 suggested that the relationship between players and the virtual characters could differ per session, while these relationships might be one of the most important parts of the simulation: "Yes, you have to approach such a policy advisor [virtual character] with conviction, otherwise you will lose him. At least, that would be the case in real life. It would be nice if different approaches could have a different effect”, and: “I think that insight into the status of relations would be of added value.”

Expected learning effects

When asked about expected learning effects, the experts confirmed the principle of learning through an immersive experience *“because you can really keep them involved for a longer period of time, they can gain a lot of experience.”* Expert 5 also mentions the aspect of gaining experience as an important point for learning. Expert 2 adds that “*they are really forced into the role of project manager, they have to be proactive (...) that is very valuable.”* Expert 1 notes: “You have to discuss and reflect on the choices you have made in order to create a good learning experience”. Consensus was found on the importance of a real-life debrief, because *“physical contact moments and reflection are also important for learning.”*

The three pilots generated both practical and substantive results. The scenarios proved to be generic enough to engage the players from different study and vocational backgrounds. During the debrief, individual progress was shown and the players shared their strategies. In a few occasions, the participants found the scenarios hard to play, but were curious about the outcome when they were not be able to finish scenario. Furthermore, the participants indicated that sometimes they would prefer to be able to meet or call the characters from the scenario in person in order to be able to talk to them directly. At the time of the debrief, it only became clear to some players that they were dealing with virtual opponents. Table 1 shows the gathered feedback in debrief sessions after finishing the playing periods.

[Table 1 near here]

4. Discussion

From the start of this design research project, the pre-set goal was to examine if it was possible to design a game-like intervention with psychological fidelity as the main carrier of an authentic learning experience. In the artefact, any tangible form, either in functions or physical elements, was avoided. The LiSMD model was used to support the design choices, the theoretical basis is described in sections 1.1,1.2 and 1.3. For a series of three pilot studies with different target groups, tailored scenarios have been developed, all around hard-to-train tacit elements of so-called 21st century skills. Five content experts and 26 players responded to four test items after play tests and scenario-walkthroughs. The BABLR prototype is currently in the intervention phase of the LiSMD, showing promising results in terms of perceived realisticness, motivation & engagement, perceived usefulness and expected learning effects.

A point of discussion may be whether the proven early indicators of success will actually result in final measurements. Here we can state on the basis of the first results, that the artefact in this line of growth will meet the set objectives. This design study shows that it is possible to achieve authentic learning in real-world issues by using purely high psychological fidelity as main carrier. What cannot be demonstrated at this stage of development is whether the use of BABLR has led to transfer or lasting learning effects, mainly because the artifact is not yet ready to generate data in the upper 2 layers of the LiSMD model.

Drawing from the work on transportation (Green and Brock 2000), it can be argued that players' experience within the BABLR artifact in the case of *high-transportation* influences existing beliefs, even though the player knows that the story is fictional. Transportation defined as *immersion into a text* or *drawing into a different place* corresponds to the immersion and perceived realisticness properties shown in BABLR. In this uptake, BABLR acts as a boundary object, providing ongoing, two-sided actions and interactions between activity systems, even when the inserted narrative (scenario) is a meaningful, but recontextualized rhetoric. Early results show that the BABLR artefact acts as a boundary object, as depicted in Figure 3, where the act of boundary spanning facilitates the actual learning. Literature describes this type of learning activities as *dialogical learning mechanisms*, triggering identification, coordination, reflection, and transformation (Akkerman and Bakker 2011).

[Figure 3 near here]

It is this process of dialogical learning that to a large extent ties in with attitudes and mindsets sought after in 21st century skills, as described in section 1.1. One final comment concerns the role of the facilitator in BABLR. During the pilots, the facilitators were the same people who developed and investigated the artifact. Despite the fact that the field experts indicated that the scenarios approached reality adequately, it seems advisable to assign the role of facilitator from the perspective of both health innovation education and the professional field. In this way, BABLR will be able to function even more clearly as a boundary object.

For the generalization of these findings it will be necessary to further explore the concept of psychological fidelity as main carrier of learning of tacit concepts of cognition in game-like interventions in other contexts and guises. When doing so, the LiSMD-model can provide a cross-domain perspective, combining medical contexts to educational and design theories. The model can be used to create space for experimenting with different manifestations of game-like interventions and other serious media, and offers a generic design research approach for future work. The LiSMD-model might even be a boundary object in itself, bridging the strict separation between medical science and design (Verkerke et al. 2013).

Acknowledgements

This study was carried out on the behalf of the research groups iHuman and Serious Gaming, both research groups of the NHL Stenden University of Applied Sciences. The BABLR artefact was developed for usage in a health innovation curriculum course for a master's degree in digital innovation in health and social work. The authors express their thanks to Dr. Ate Dijkstra and Dr. Hylke van Dijk for support. You rock.

Compliance with Ethical Standards

On behalf of all authors, the corresponding author states that there is no conflict of interest and Informed consent was obtained from all individual participants included in the study. For this type of study formal consent is not required.

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Pilot		N	Characteristics	Mean
Design - viewed a prototype				
	Expert Panel	5	field experts	
Preview - tested a scenario				
	1 group questionnaire and interview	7	bachelor students social work	
-	perceived realisticness			4.34 / 5
-	motivation / engagement			3.75 / 5
-	perceived usefulness			4.01 / 5
-	expected learning effect			3.42 / 5
Users - participated in a trial				
	1 group group-interview	10	bachelor students	
	1 group questionnaire and group-interview	9	social work professionals	
-	perceived realisticness			3.87 / 5
-	motivation / engagement			3.05 / 5
-	perceived usefulness			3.25 / 5
-	expected learning effect			3.39 / 5

Table 1. Average scores for artifact scoring conditions, both from experts and students

Figure 1

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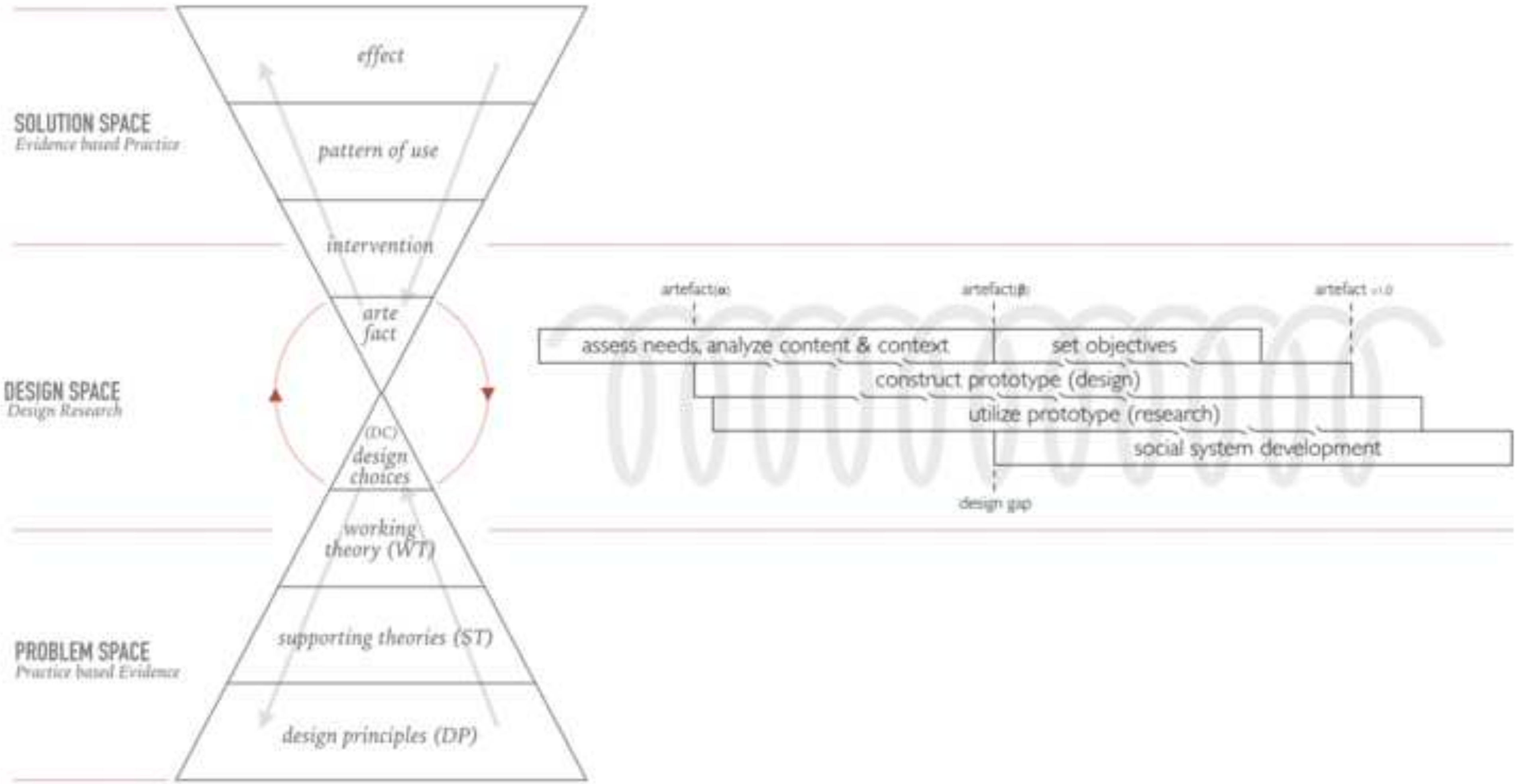

Figure 2

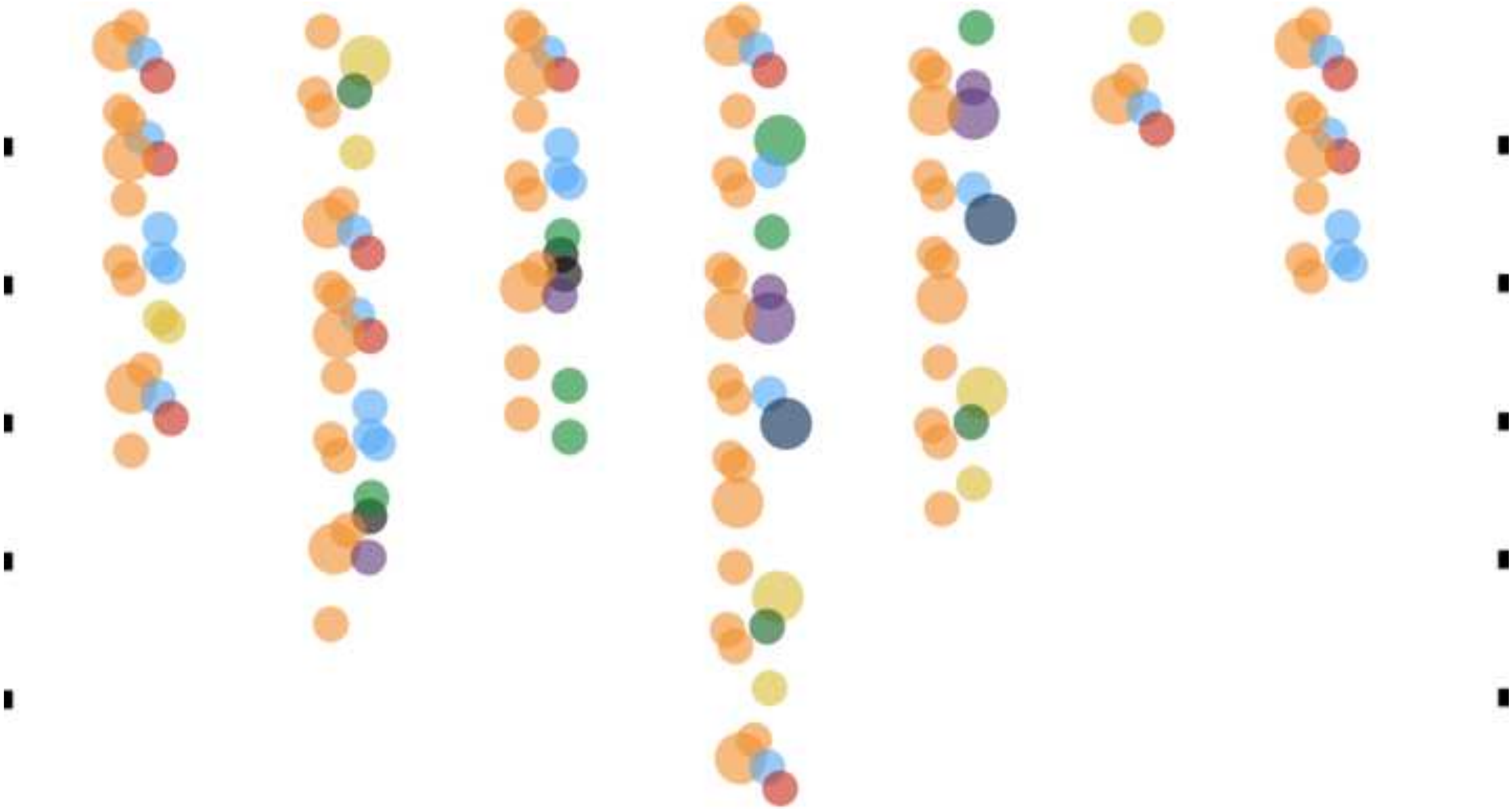

Figure 3

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