

Chapter 3

Game Design in Financial Literacy: Exploring Design Patterns for a Collaborative and Inclusive Serious Game from Different Perspectives



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3.1 Game-Based Learning as an Approach for Inclusion¹

The National Decade of Literacy and Basic Education in Germany aims to improve literacy and basic skills in areas, which are relevant to everyday life such as health, finance, and nutrition (Bundesministerium für Bildung und Forschung [Federal Ministry of Education and Research], 2015). Basic skills in reading and writing are regarded as an individual antecedent for social participation (Abraham & Linde, 2018; Sting, 2005). The literacy and basic numeracy skills of everyday life are understood as literacy in the narrower sense. The broader understanding of the term also includes the handling of knowledge (Sting, 2005). According to the Level One study, which measures adult literacy at different levels of competence, 6.2 million German-speaking adults between the ages of 18 and 64 living in Germany have reading and writing difficulties. The percentage of adults with reading and writing difficulties in the total population is thus 12 percent. Despite a low literacy rate, 62.3 percent of these adults are gainfully employed, and 76 percent have received a school diploma in their educational biography (Grotlüschen et al., 2019).

The concept of basic education is a broader concept than literacy work (Kastner, 2016). In addition to the fostering of reading and writing skills (literacy), basic education includes in particular the learning fields of media/computer literacy,

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health literacy, food literacy, financial literacy, civic literacy, and basic foreign language skills (Abraham & Linde, 2018; Mania & Tröster, 2018; Tröster & Schrader, 2016). Mania and Tröster (2014) understand basic financial education as part of basic economic education. The necessity of financial literacy can be explained on the one hand by the economic and financial crises taking place at the macro-level (Apréa et al., 2012). On the other hand, the high per capita indebtedness of private households, precarious employment, complex financial services, and the need for private provision can be observed at the micro-level (Remmele et al., 2013). Mania and Tröster (2018) postulate that new groups of learners for basic education can be reached through other content areas. With thematic content areas such as finance, politics, and health at the level of basic education, it should be possible to reach new participants. The action- and lifeworld-oriented topic ensures a learning transfer into everyday life and maintains the motivation for learning in basic education. Further developments of the content of basic education will enable new strategies, actors, and places of learning (Mania & Tröster, 2018). In addition, basic education in finance enables both social participation (Mania & Tröster, 2015) and employability by increasing autonomy, self-determination, trust, and feelings of value (Engartner, 2016). Basic education is contextualized in lifelong learning (Abraham & Linde, 2018). Basic education is thus also understood as an instrument of labor market integration (Mania & Tröster, 2015). The addition of general content relevant to the world of work and life in literacy work is necessary to strengthen the learning motivation of the less literates (Huck & Schäfer, 1991). While literacy has been discussed in Germany for some time, research on the design of learning settings at the basic education level can still be expanded. The scientific knowledge on courses of basic financial literacy is less extensive. There are a small number of basic education courses that teach financial literacy (Mania & Tröster, 2018). Existing courses are more likely to address school education or vocational education and training.

Literacy and basic education courses are offered by civic associations, prisons, and adult education centers (Volkshochschulen). Courses include formats such as literacy courses, preparatory courses for obtaining school diplomas, literacy courses prior to integration courses, or open learning cafes (Mania & Thöne-Geyer, 2019). Löffler and Korfkamp (2016) refer to the target group-specific (rather negative) learning experiences that are associated with complex demands on teachers when planning and designing literacy and basic education courses. National and international studies show that teaching–learning processes of adults in literacy and basic education receive little attention (LEO, Grotlüschen et al., 2019; PIAAC, OECD, 2009). The findings of the AlphaPanel also indicate that there is little evidence of learning progress in literacy courses (von Rosenblatt & Lehmann, 2013). The assessment of the written language competence of participants with diagnostic procedures is rejected by course teachers (Bonna, 2015). Because the target group is often learning disabled, lives precariously, has low self-confidence, and needs to learn, how to learn (von Rosenblatt & Lehmann, 2013).

Overall, participants in literacy courses are often learners with specific learning impairments, concrete learning disabilities, and without educational socialization (von Rosenblatt & Lehmann, 2013). Thus, the target group of literacy courses

Table 3.1 Gbl in inclusive literacy courses

Success patterns for literacy classes	Gbl as an inclusive approach
(Re-)start of learning	Reduction of access barriers
Discover the fun of learning	Motivation of learners
Receiving suggestions for everyday life and work	Reaching other groups of learners
Knowledge transfer in private/professional context	Development of social bonding structures

requires an instructional setting that is internally differentiated and inclusive. This contribution argues that learners who cannot go through typical learning processes can be integrated via a serious game (SG). Game-based learning (gbl) offers various advantages that are shown in Table 3.1, which are comparable to the success criteria of basic education courses (Abraham & Linde, 2018).

Given these advantages of gbl in basic education courses, the aim of this contribution is (1) to identify the design principles from teaching practitioners in financial literacy learning settings, (2) to structure it based on central learning theories in SG, and (3) to discuss it in a context of increasing collaboration requirements. In the first step, the recommendations from practice for practice based on a document analysis are grouped into eight principles for game design. In a second step, the game “Curve,” developed by the literacy/basic education practice, will be structured along the content and instructional characteristics of SG (Castell & Jensen, 2003). In a third step, the identified principles for designing inclusive learning settings in basic education are intertwined with the design elements of the inclusive SG to develop the SG theoretically as an intervention for fostering collaborative problem-solving (CPS; Fiore et al., 2017; OECD, 2017) skills. Due to changing market and work situations, new collaboration requirements arise for learners. Therefore, the collaboration will be fostered and assessed in the SG. The contribution thus addresses research desiderata but also stimulates the goal-oriented further development and design possibilities of game design in literacy in order to be able to react proactively to current developments.

3.2 Assumptions and Theoretical Derivations for Serious Games

For the analysis of the inclusive SG *Curve* regarding content and instructional characteristics of SG (Castell & Jensen, 2003), it is useful to first outline the theoretical background of SG. SG combines knowledge transfer with playful activity. In doing so, motivational factors of computer games are integrated with teaching-learning methods to aim at an active knowledge construction in authentic contexts. The field of application varies between training, enlightenment, recreation as well as didactic design possibilities (Blötz, 2015). If playful elements are used in SG in a reflective manner to impart knowledge, they increase the motivation and self-efficacy of the

learners. This is possible if feedback mechanisms and individual learning processes (interests and learning pace of players) are considered in the conception of SG (Blötz, 2015). An SG can be characterized by the following criteria: (1) learning takes place casually in the game; (2) the game has rules; (3) winning is objective and possible; (4) in case of misconduct, achieved game points are not reduced; (5) games are played as intended; (6) games are less efficient in learning than other methods; and (7) teachers do not believe in games (Becker, 2017b). First, it is necessary to identify the game design in the *SG Curve*, and therefore the first research question (RQ1) is:

- RQ1: Which principles guide practitioners of basic education/literacy in designing learning settings in financial literacy?

SG links education and training with labor market skills and leisure activities. SG or simulations promote skills that will be required by employers in the future and are not taught adequately at school (Jackson Kellinger, 2017). In addition to the ability to solve problems, critical thinking, communication, and collaboration, especially in SG, the requirements for gamers include creativity and an innovative mindset. Players are characterized by the adoption of new identities and perspectives, their perception as problem solvers, and the understanding of mistakes as a learning opportunity (Gee, 2003). While playing, they test hypothesis-like developed game strategies to eliminate cognitive dissonance (van Eck, 2007). The learning approach in SG is based on constructivism. The idea is that learners construct knowledge through discovery learning (Bruner, 1961). Through the variety of game possibilities, trying out the game world, and direct feedback, learners in SG can learn from their mistakes and take risks (Gee, 2003; Prensky, 2001; Shaffer, 2006). The theory of situated cognition also requires that learning has to be embedded in an authentic context in order to explore contexts (Achtenhagen, 2002; Driscoll, 2005; Winther, 2010). SG should be designed in terms of content and instructional processes along with different approaches and theories for the specific design of learning support. The transfer of evident learning theories to SG can be found in Castell and Jenson (2003). Here, meta-analyses prove that the use of SG makes sense from a pedagogical point of view, since an increase in performance (Marzano, 2010), knowledge availability (retention), cognitive gains, and a better attitude toward learning content can be observed. This leads to the second research question (RQ2):

- RQ 2: Which design elements of gbl are implemented in the *SG Curve*?

The transfer of SG to real situations is particularly successful when the SG environment is moderately adapted to reality and real-world variables are limited for simplification (Gee, 2003; Grabe & Grabe, 2007). The ability of players to work in a team and communicate is promoted as they create affinity spaces (Gee, 2007) for exchange and establish a gaming culture based on experience. Collaboration is found both in the research by (1) educationalists Webb and Palincsar (1996) as the best form of learning (Squire, 2011) and in (2) game literature by Prensky (2006). Cooperation, esp. CPS, in groups or pairs, is called a twenty-first-century skill (Andrews et al., 2017; Graesser et al., 2018; von Davier & Halpin, 2013). When SG

is played in dyads, participation, commitment, and learning outcomes are greater than when learners play alone (Schrier, 2007; Squire, 2011). Playing in dyads (1) promotes action–reflection through decision discussions, (2) verbalizes the intentions and thoughts of players, and (3) enables the sharing of problems within a game (Squire, 2011). Players describe playing in dyads as a way to share ideas and tasks, have small debates, remember information better, develop decision-making skills, and as a way to reflect (Schrier, 2007). This playing and collaboration within the SG encourage critical thinking, collaboration, and problem-solving skills. In other words, those skills are called future work skills (Davies et al., 2011). With a focus on inclusive teaching, teachers will be faced (in the future) with the challenge of teaching and promoting collaboration skills in the best possible way for all learners, regardless of their individual learning needs. This is the reason for a third research question (RQ3):

- RQ 3: To what extent can the practical and theoretical perspectives of designing an SG in financial literacy be intertwined to foster and assess CPS among learners?

The research questions are answered subsequently.

3.3 Designing a Serious Game in the Field of Financial Literacy

3.3.1 *Design Principles from Teaching Practitioners*

To answer the RQ1, which principles guide practitioners of basic education/literacy in designing learning settings in financial literacy, a document analysis (Lamnek & Krell, 2016; Rädiker & Kuckartz, 2018) was conducted. Here, publications available on the project website are used as documents. The analysis includes 35 German-language publications in journals, edited volumes, or monographs of the CurVe II project team. Thus, a broad spectrum of dissemination can be considered. The period covers the years 2016–2020; the number of published papers totals 2016 (10), 2017 (5), 2018 (5), 2019 (8), and 2020 (7). The documents are evaluated using content analysis (Mayring, 2015). To answer the research question, the recommendations were keyworded and categorized into eight principles in a first step of analysis (e.g., Deutsches Institut für Erwachsenenbildung [German Institute for Adult Education], 2019). In a final deductive analysis, all recommendations of the inductive categorization could be assigned to this scheme. The eight identified principles are presented in Table 3.2.

The identified design principles help teaching practitioners as well as learners. The design principles go back to the teaching–learning theory instructional approach of anchored instruction (Brown et al., 1989; Cognition and Technology Group at Vanderbilt [CTGV], 1997; The Cognition and Technology Group at Vanderbilt

Table 3.2 Identified design principles from practitioners in the field of financial literacy


Design pattern	Description
Practical orientation	Materials should be usable in different settings by teachers with different teaching experiences.
Modularity	Materials should consist out of small and flexible units, which addresses the need, life circumstances and competences of low literate adults.
Openness and flexibility	Materials should be modifiable and supplemental and flexible regarding the needed time and different units.
Target group-spreading	Materials should be designed for different and heterogeneous target groups.
Learner orientation	Materials should be authentic and designed along realistic experiences, competencies, interests, and needs of low-literate adults.
Competence orientation	Materials should be built on a systematic competence model, developed along everyday requirements in different degrees of difficulties, and promote competence to act.
Connectivity and sustainability	Materials should be integrable into existing curricular/concepts in a different course.
Testing and trial	Materials should be theory-driven, tested by users (teaching practitioners and learners).

[CTGV], 1990). The approach emphasizes instructional ways to avoid inert knowledge in a particular way. To this end, learners are provided with narrative anchors that can be used to establish an everyday or real-life connection to specific learning content. The anchors make it easier for the learners to identify with the learning content, to experience it as relevant, and to transfer the acquired knowledge later in order to be able to recognize and solve further, similarly structured requirements on their own.

3.3.2 *Game-Based Learning Design Elements Applied to “Curve”*


To answer the RQ2, which design elements of gbl are implemented in the SG *Curve*, the designed SG is presented along with learning theories in Table 3.3. Here, the design elements are considered to complement each other to add pedagogical value.

Table 3.3 Applied gbl design elements, which foster learning in an SG in the field of financial literacy

Design elements to foster learning within an SG	Application in the SG <i>Curve</i>	Graphic implementation
Creating a storyline	The game takes fictional places at “Maisenbohn”, where a fictional family “Mueller” live. The learners help one family member of the <i>Muellers</i> through different everyday tasks within financial topics, e.g., buying groceries at the supermarket	
Setting goals	The game’s final goal is to help one family member to get their task done. Therefore, the learners get an order, on which the task is described. Within the fulfillment of the specific order, learners have to solve calculating exercise or take part in a quiz about financial topics	Learners help a family member of the Mueller’s (figure) to finish a financial task (in thoughts) at a specific place in Maisenbohn (house). During their walk through the village (grey dots) they will take part in financial quizzes. In these quizzes learners have to earn a specific amount of coins (orange dots) and get a specific amount of help at fields with question marks (?). The difficulty of the order for the learner/task of the family member varies between easy, middle, and hard (number in the square)
Providing a risk-reduced environment (Bransford et al., 2000)	The consequences of the taken decision within the game stay in the fictional village <i>Maisenbohn</i> and have no real-life consequences. The learners can improve their action with a next order or specific task of a family member	
Having a reward system (Skinner, 1953)	Learners will take part in quizzes while they guide their family members to fulfill the task a specific place (e.g. employment office). For a correct solution, they got coins, which are needed to complete an order	
Introducing knowledge when needed or relevant (Bransford et al., 2000)	The family member/learner is hiding to a specific building, where he can finish his task. During their walk, they get domain-relevant tips, e.g., at the public library or an advisory office	
Providing “scaffolding” (Vygotsky, 1978), or supports a student needs to learn something	The game provides hints in form of tips and there will be a video-based glossary	

(continued)

Table 3.3 (continued)

Design elements to foster learning within an SG	Application in the SG <i>Curve</i>	Graphic implementation
Employing “metacognition” (Bransford et al., 2000)	The game gives learners the ability to take on multiple roles. Family Mueller consists of eight different personae	
Inducing “flow” (Csikszentmihalyi, 1990), or a state of total engagement	The fictional family “Mueller” helps the learners to identify with the authentic problems. On the one side, learners are motivated to solve the problem for the family member and on the other side are keen to get more financial educated for their own real lives	
Providing “contrasting cases” (Bransford et al., 2000)	The order, which the learners have to fulfill for their family member to solve a task, is designed along with different sub-competence domains and differs in the degree of difficulty	

Family Mueller consists of eight stereotypic persons with different financial problems (in brackets) and a family dog. There is the mum Marie (e.g., retirement planning, cessation of alimony), her second husband Michael (e.g., buying a car) and their daughter Mona and her first son Max (e.g., opening a bank account, first payroll) from her first husband Thomas (e.g., becoming unemployed) and her parents Matilde (e.g., retirement) and Manfred (e.g., debts). Mustafa is a friend of Max and needs financial help as well (e.g., liability insurance, electricity billing, cell phone tariffs)

The SG *Curve* is supplemented by events that make it more difficult or easier to fulfill the game task. Events deal with positive aspects (e.g., winning a competition, selling clothes that have been sorted-out), negative aspects (e.g., additional payment of service charges, parking ticket for parking in a no-parking zone), or social aspects (e.g., calculating vacation costs, financing a bike wish). Overall, events provide game tension and can be solved individually or collaboratively

3.3.3 Linking Practitioners' Principles and Theory-Driven Game Design Elements to Foster Collaborative Problem-Solving

To answer RQ3, to what extent can the practical and theoretical perspectives of designing an SG in financial literacy be intertwined to foster and assess CPS among learners, it is first outlined why CPS is a new requirement in the twenty-first century. Due to changing market and work situations, new collaboration requirements are emerging overall. Ongoing digitization is changing the requirements for human–human and human–machine interaction. This also affects the less literates. Compared to individual work, collaboration offers advantages in terms of (1) more effective use of work; (2) a greater scope of knowledge, perspectives, and experience; and (3) more creativity based on the ideas of the group members (OECD, 2017). Collaboration does not achieve better results per se; what matters is the effectiveness of the collaboration. CPS is a type of collaboration that, in the educational context, refers to both the cognitive and the social dimensions of interaction (Griffin et al., 2015). The SG aims to foster their collaboration skills (social component of CPS) and their learning progress in financial literacy (cognitive component of CPS).

Barkley et al. (2014) briefly summarize theoretical background and scientific findings for collaborative learning in digital learning environments. They conclude that, like on-site learning, it is based on theoretical foundations of learner-centered teaching research and contributes to social constructivist learning research. Learners actively construct their knowledge and link it to previous knowledge and experience. Learners in digital learning environments acquire digital skills, such as the assessment of resources available online or effective online communication. It is believed that training enhances this effect and that effective communication is essential in collaborative processes. Furthermore, a digital learning environment with structure-giving elements can support learning novices until they can become active on their own. Scaffolding is important in digital learning environments from the perspective of teachers as it is the case with collaborative learning (Major, 2010, 2015). Digital learning environments offer numerous possibilities to collect and create knowledge (Barkley et al., 2014; Hillebrand, 1994; Reither & Vipond, 1989). Higher performing learners are more likely to benefit, while lower performing learners need support (Kirschner et al., 2006). This typical aptitude–treatment interaction (ATI) shows that there is no one optimal teaching method for all. This ATI is contrasted with the finding that weaker learners benefit from performance heterogeneous groups (e.g., for the field of mathematics see Fuchs et al. (1996)). For average learners, performance-homogeneous groups are more effective, while group composition has no effect on the best performing learners. The need for support and the individual performance in collaboration are therefore related.

The intertwining of practice and research perspectives thus takes place through the fostering of CPS. While the practice perspective mainly takes into account design principles that aim at the heterogeneity of the literacy/basic education setting, the gbl design elements bring constructivist learning theories into play.

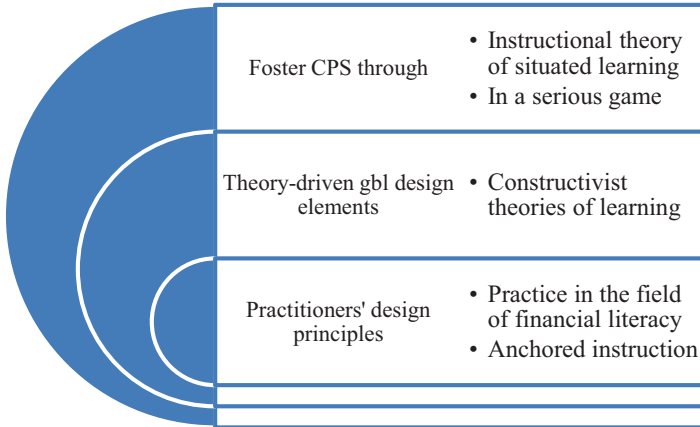


Fig. 3.1 Linking practitioners' principles along the anchored instruction approach and constructivist game design elements to foster CPS in situated learning settings within an SG

Figure 3.1 illustrates the intertwining of perspectives.

The fostering of CPS is linked to an instructional learning setting, the SG, which can be theoretically contextualized through the situated cognition approach: The interventions that address the social and the cognitive components of CPS and are situated in teaching-learning theory. From a constructivist or gbl research perspective, the central assumption is that knowledge is constructed by learners (Becker, 2017a; Webb et al., 1995). The design is based on the theory of situated cognition, in which anchored instruction can also be placed. Learning (and instruction) in this tradition are understood as active, constructive processes in a particular context of action. Knowledge emerges from the interaction between learners and situations under the following premises (Law & Wong, 1996; Resnick, 1991): thought and action can only be understood in contexts, learning is always situated, and knowledge is actively constructed by the perceiving subject, the learner, and constitutes shared knowledge. In the new moderately constructive instructional approach of situated learning, the aspect of situatedness and social interaction is combined with the results of empirical cognitive research. Knowledge acquisition in situated learning can be described based on process characteristics as active, self-directed, constructive, situational, and social. For this purpose, complex teaching-learning arrangements (Achtenhagen, 2002; Winther, 2006) have to be designed. The central principle of the learning theory conception is that learning can take place along narrative and new situations that are close to life or the professional field. This principle combines the principles of practice with those of gbl.

The practical implementation of the intervention should take place in a triadogue. The extension of a human-agent dialogue by another agent to a triadogue (conversational triadogues) improves learning and assessment (Graesser et al., 2017). Multiple agents have been used in various learning environments (including Betty's Brain (Biswas, 2010), iSTART (Jackson & McNamara, 2013), or Operation ARIES!

(Forsyth et al., 2013; Halpern et al., 2012), in various assessments (including trialogues in Zapata-Rivera et al., 2015, tetralogues with two agents and two humans Liu et al., 2016). The scientific literature focuses on the different configurations of trialogues to understand how trialogues can be used productively for learners, topics, deeper learning, and assessments (Cai et al., 2014; von Davier et al., 2017; Zapata-Rivera et al., 2015). As trialogue design criteria, Graesser et al. (2017) elaborate exemplary criteria for assessing CPS. Application in learning and assessment environments varies. The AutoTutor that was used in the Center for the Study of Adult Literacy helps over 16-year-olds to improve their reading skills (Graesser et al., 2015). In the assessment development, in addition to low literacy, learners’ self-concept is taken into consideration by enhancing motivation and self-esteem through two design criteria. The design criteria are presented in Table 3.4 and adapted to the SG *Curve*.

Hence, the proposal of fostering CPS is equally connectable to current assessments of CPS. Currently developed assessments measure collaboration by performance in cooperative games and simulations. Assessments are implemented in interactive two-person games or simulations (Griffin, 2017; Hao et al., 2017), in

Table 3.4 Design elements to assess and foster cognitive and social component of CPS in an SG

Design element to foster CPS	Applied to the SG <i>Curve</i>	Fostering CPS
Two agents talk with each other and they will ask a yes-/no-question to the learner	Icebreaker questions for learners with little prior knowledge can be realized through additional video sequences. The video can visualize a discussion about the situation of the financial task from a family member of the Mueller’s with a nonplaying character (e.g., an uncle). The financial problem is the order that the learner has to fulfill successfully. The video can end with a yes-/no-questionnaire, which will be scored automatically. The questionnaire addresses the understanding of the problem and integrate at the same time design principles from the teaching practice and from the gbl in a form that the learning goals derive from the competence model, the storyline fits to family Mueller and a real-life problem is offered to the learners, which have to be solved during the game	Foster cognitive component of CPS <ul style="list-style-type: none">• Task regulation• Knowledge building
A playful competition between peer-agent and expert-agent motivates the learner as a viewer	The game integrates different events (negative, positive, social). When a player enters a specific field on the game board, he has to pull an event card. The social events cards could offer an additional video sequence (via QR-code), where non-playing characters (e.g., an aunt of family Mueller) addresses social elements like participation (e.g., the aunt presents a part of the solution and asks the learner to complete the task), perspective taking (e.g., the aunt tells different opinions from her friends and ask the learner to collect different ideas from their group) or social regulation (e.g., the aunt shows her strengths and weaknesses and ask the learner to recognize his strengths and weaknesses)	Foster social component of CPS <ul style="list-style-type: none">• Participation• Perspective taking• Social regulation

multi-player games (Zhu & Bergner, 2017), or in problem-solving contexts in which collaboration is carried out with a human agent (Graesser et al., 2017). Collaboration skills are also measured in automated tutoring systems in which dialog data (Graesser et al., 2017; Griffin, 2017; Olsen et al., 2017) or eye-tracking data (Olsen et al., 2017) are evaluated.

3.4 Impact of Serious Games in Financial Literacy

Financial literacy teaches basic knowledge of money and payment transactions to secure one's own existence and to cope with everyday monetary issues, which are becoming increasingly complex (Aprea et al., 2012; Mania & Tröster, 2014). To enable teachers to professionalize financial literacy and establish it as a component of literacy and basic education, this research highlights the importance of SG. SG is an instructional instrument with which the low-literate persons who cannot go through typical learning processes can be integrated. The SG Curve is an educational innovation in the field of financial literacy. On the one hand, the cognitive needs of financial literacy and, on the other hand, the learning-promoting potential of gbl (cognitive + social dimension) are combined to enable participatory involvement (social dimension) in society. The analysis of the development of learning settings shows that practitioners are guided by eight principles, and theoretical gbl criteria can be applied to the SG Curve. The practical and theoretical results have been developed along the design-based research (DBR; Reeves, 2006) approach. This is primarily focused on generating theories to solve authentic problems. The findings show that practitioners are good instructional designers. Learning materials, which are designed with instructional theories, support the teaching-learning processes in basic education courses. Thus, the DBR approach is an appropriate and adequate research paradigm when it comes to developing inclusive SG. As scientists within DBR take the initiative to trigger new design processes, this paper proposes that inclusive SG to be extended to incorporate CPS. Since the SG is inclusive and developed along gbl design elements, the two components of CPS are proposed for fostering. As a result, an agent-based triadology is proposed that embeds cognitive and social components of CPS into the game story via additional personae.

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