

Supporting Employee Engagement and Knowledge Transfer via Gamification in the Context of Sheltered Workplaces: A Literature Review and Interview Study

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Abstract. Gamification describes the use of game design elements in non-game contexts. It is used in various domains to motivate users to exhibit a desired behavior. Gamification is applied in industrial settings, to motivate employees and improve quality. However, gamification with the aim of fostering knowledge sharing and in user groups with disabilities is underexplored and limited to case studies in specific use cases. This paper investigates the applications of gamification in sheltered workplaces for people with disabilities and identifies research directions. It reports a literature review and a qualitative interview study to identify motivations of employees and suggest matching gamification mechanics. Our findings indicate that gamification mechanics for these environments should avoid performance pressure and focus on motivations such as social relatedness and emphasize the achievement of teams. The paper presents and motivates prototypes of these mechanics.

Keywords: Gamification, Sheltered Workplaces, Production, Knowledge Sharing, Universal Design.

1 Introduction

Gamification describes the use of game design elements in non-game contexts [6]. Gamification is often associated with the mechanics of points, badges, and leaderboards (PBL). Players earn points and badges for meaningful achievements and are then ranked on a leaderboard to compare their performance with that of their peers. PBL is the prevalent gamification mechanic in various domains [11]. There are many other gamification mechanics that address different motivations, such as avatar development, quest pursuit, or social connectedness. Various frameworks (e.g., the Octalysis framework [3]) structure these gamification mechanics.

Several studies point to the positive effects of gamification in different domains. Examples include manual work processes in production [19] and education [1]. Existing applications focus on improving performance and quality, while other outcomes of gamification remain underexplored. For example, using gamification to promote knowledge sharing can increase job satisfaction and thereby positively impact the quality of work. Furthermore, most existing gamification projects do not address the needs

of people with disabilities. By including the needs of people with disabilities in the design process, we can develop a solution that can be used by a wide range of people with different skills and abilities without the need for adaptation, and realize the principles of the universal design movement [2].

This paper contributes a research outline for the development of gamification mechanics for knowledge transfer in sheltered workplaces. The gamification mechanics address the needs of people with disabilities and should motivate knowledge transfer and enhance job satisfaction.

- It reports a qualitative literature review on the research area of gamification in industrial environments. It summarizes the research work and derives implications for gamifying additional work tasks, such as knowledge transfer.
- It reports an interview study in a sheltered workplace. The interviews address the motivations of employees to share their knowledge. It proposes gamification mechanics to support knowledge transfer.

2 Theory of Gamification

Gamification, the use of game elements in non-game contexts, has been established in several domains. The first part of this section provides an understanding of a game and its elements. The second part summarizes theoretical frameworks. Applications of gamification are summarized in the third section. A detailed discussion of gamification in industrial applications is provided in the following section.

2.1 Elements of Games

Gamification refers to the concept of game rather than play. While play is characterized by a broader and more open-ended interpretation, the definition of a game has elicited considerable scholarly debate. Suits (1978) describes a game as an effort to achieve a specific objective within a framework of established rules [25]. Jane McGonigal summarized the elements of games in her publication, "Reality is Broken: Why Games Make Us Better and How They Can Change the World." [23]. These elements include the objective, rules, a feedback system, and voluntary participation. The elements of games constitute a formal system that operates beyond the realm of ordinary life [4].

2.2 Theoretical Foundations

Different frameworks provide a structure to develop a gamified application: the game elements hierarchy by Werbach and Hunter (2012) [36], the Self-Determination Theory, along with the concept of intrinsic motivation by Deci & Ryan (1985) [5], and the Octalysis framework by Chou (2016) [3].

Game Hierarchy. Werbach and Hunter's Game Hierarchy describes the use of game elements in non-gaming contexts to increase engagement, motivation, and goal attainment [36]. The framework consists of:

- **Dynamics:** These dynamics represent the deeper emotional and psychological effects generated through the utilization of gamification mechanics, which influence the motivation and engagement of users.
- **Mechanics:** Actions and processes that maintain game activity and direct player interaction, such as point systems and challenges.
- **Components:** Visible elements like points and badges, directly perceptible to players and often the primary focus in gamification.

This hierarchy aims to deepen the understanding of how game elements at various levels can enhance engagement and motivation, influencing real-world behavior change and learning.

Self-Determination Theory (SDT). The SDT by Deci and Ryan (1985) [5], is a psychological theory of human motivation, emphasizing the influence of intrinsic and extrinsic motivations on behavior. SDT posits that optimal functioning and realization of potential are contingent upon satisfying three basic psychological needs:

- **Autonomy:** The need for self-direction and personal approval of one's actions.
- **Competence:** The need to effectively meet challenges and develop skills.
- **Relatedness:** The need for connection and interaction in a social context.

SDT suggests that meeting these needs enhances intrinsic motivation, leading to outcomes such as increased engagement, satisfaction, and overall well-being.

Octalysis. Yu-kai Chou's Octalysis Framework (2016) is a gamification model centered around eight core drives of human behavior [3]. These drives include:

- **Epic Meaning & Calling:** Engaging in something greater.
- **Development & Accomplishment:** Pursuit of progress and achievements.
- **Empowerment of Creativity & Feedback:** Creative expression and immediate feedback.
- **Ownership & Possession:** Desire for control and accumulation.
- **Social Influence & Relatedness:** Social elements like competition and collaboration.
- **Scarcity & Impatience:** Yearning for rare or exclusive items.
- **Unpredictability & Curiosity:** Need to discover upcoming events.
- **Loss & Avoidance:** Motivation to avoid loss or negative outcomes.

This framework is applied in product gamification, education, and marketing to enhance user experiences and influence behaviors. Chou emphasizes a balanced application of these drives for effective gamification design.

Discussion. The Game Hierarchy highlights the importance of structured mechanics and visible components in shaping the user experience, while SDT emphasizes the fulfillment of intrinsic psychological needs – autonomy, competence, and relatedness – for optimal motivation. Octalysis extends this understanding by mapping eight core drives that influence human behavior, offering a comprehensive view of motivational factors in gamification. These frameworks provide a robust theoretical foundation for designing gamified applications that engage and motivate users by balancing external rewards with intrinsic motivational elements.

3 Sheltered Workplaces

Sheltered workplaces are special environments that provide employment opportunities for people with cognitive or psychological disabilities. They provide structured workplaces that are specifically adapted to the needs of people with disabilities and support their skills development and independence. Sheltered workplaces are funded by the government and by providing services to the market. They sell their own products and provide services to other companies. Typical services include manual tasks such as commissioning, manual assembly, packaging, sorting, or printing.

Each team has a team lead who serves as the first point of contact for the employees and organizes the team's work processes. Work processes are adapted to the abilities of the employees. We chose a sheltered workplace as the application environment for the following reasons.

- Considering the needs and abilities of people with impairments, helps to develop a universal solution that benefits a diverse group of people, in the sense of universal design [2].
- Sheltered workplaces provide usage scenarios at the edges of the application context. This fosters the understanding of the robustness, flexibility, and overall performance of the gamification system.

These environments are open towards assistive technology. The introduction of technological assistance systems allows their employees to be more independent and participate in more complex processes.

4 Applications of Gamification

Gamification is applied in various domains. Question-and-answer platforms often allow to earn badges. Stack Overflow awards badges to reward helpful interactions, such as providing helpful answers. Badges grant new permissions, such as the ability to edit other answers. A meta-study confirms the potential of gamification, for instance in education [1]. One aspect that was associated with positive changes is social interaction. This is promoted by competitive and collaborative elements [29]. Pakinee and Puritat evaluate gamification elements, such as a ranking system that groups students based on

their participation to enhance participation over time [26]. Another frequent application is in industry. This application is discussed in the following section.

4.1 Gamification in Industrial Environments

Gamification has been introduced in industrial environments and is expected to make workers more productive and reduce their error rate. Gamification can make manual tasks more engaging and increase job satisfaction. However, gamification in industry is still underexplored and the adoption is low [15]. Studies focus on case studies and are reported without quantitative evaluations [34]. A recent review concluded that research on the potential of specific gamification elements in industrial environments is needed [15]. Only few studies have been conducted in sheltered workplaces and have addressed the needs of people with disabilities, such as the study by Korn et al. [19].

In Industry 5.0, assistive systems aim to train users in acquiring new skills tailored to their individual needs and motivations [14]. Personalized gamification aligns with this objective. In addition to addressing sensory, cognitive, and motor aspects [24], it considers psychological differences, such as motivations, when determining the suitability of game elements [16]. The application of personalized gamification in production environments, especially in sheltered workplaces, is underexplored.

This literature review investigates gamification mechanics and their impact on psychological outcomes. In sheltered workplaces, the quantitative performance is often less important than the psychological outcomes. Therefore, we focus, in line with the "three primary elements of gamification" as described by Huotari and Hamari [13], on the psychological outcomes rather than performance.

4.2 Literature Review

Search Strategy. The articles were collected by searching scientific databases including "Science Direct", "IEEE Xplore", "Springer Link" using the search terms [Motivation, Gamification, Incentives]; for the application area, the search terms "Continuous Improvement Programs (CIP), Production, Industry 4.0, Manufacturing, Shop Floor Management". Articles that describe the application of gamification in industrial environments were included based on a screening of the abstract. We excluded articles that were not in English or not accessible completely.

Since the field is interdisciplinary and the area of application "improvement processes in production" has diverse names in different domains, the literature research was conducted in a snowball system. The review is not exhaustive and aims at providing an overview of the current approaches in gamification and evaluations.

Classification of the Articles. The literature included in the review was analyzed using the following classification schema: industrial context, described gamification mechanisms and elements, methodology, and identified psychological outcomes. While comprehending the gamified content aids in contextualizing gamification strategies, the methodology provides insights into the quality of the conducted studies.

4.3 Results of the Literature Review

The complete results of the review are given in the appendix (see **Table 1**)

Applied Gamification Elements, Mechanics and Dynamics. The literature review confirmed existing meta studies on gamification in other domains. Common gamification elements such as badges (6 occurrences) [7, 8, 15, 21, 33, 34] points (8 occurrences) [15, 20, 21, 30, 32–35] leaderboards (5 occurrences) [15, 21, 30, 32, 34] and rewards [7, 34] were present in the surveyed literature.

The following mechanics were most frequently utilized: progress bars (8 occurrences) [7, 15, 17, 18, 20, 28, 32, 35]; feedback [15, 17, 18, 20, 21, 28, 34, 35], levels (7 occurrences) [8, 15, 18, 30, 33–35], leaderboards (5 occurrences) [15, 21, 30, 32, 34] and displaying performance (4 occurrences) [7, 20, 30].

Time-related elements such as countdown timers [30] and daily quests [30] were also prevalent. Finally, goals were also frequently mentioned as employed gamification mechanisms (as mentioned in [7, 18, 35]). While the mechanics are partially absent, the connection between mechanics and dynamics, such as the overall narrative and the intended emotions, is also scarcely elucidated.

Psychological Outcomes. The literature review indicates that gamification enhances motivation for tasks, such as performing repetitive activities [18, 20, 21, 32, 33]. It also increases attention and perceived task relevance [31]. Furthermore, significant positive emotions are reported [17], including specific enjoyment of the task [17] and 'worthful emotion' [28]. Satisfaction is also heightened in gamified simple tasks within an industrial context [18, 21]. However, it is noted that gamification generally elevates emotional arousal [28], which may include negative emotions such as anger [17] and stress [7, 8]. These findings indicate that the implementation of gamification in sheltered workplaces must be approached with sensitivity, and negative emotional effects such as stress and anger should be anticipated during the design.

Discussion. Notwithstanding the documented presence of psychological outcomes, the predominant focus of most papers within our literature review lies in the enhancement of work task efficiency, thereby primarily targeting performance motivation. It is crucial to note, however, that in sheltered workplaces, performance motivation is not the primary concern, and the potential adverse psychological repercussions stemming from performance-oriented gamification necessitate consideration, as underscored by initial indications found in studies conducted by Korn et al. in 2019 and 2015 [17, 18].

The broader motivational constructs to be delineated through the incorporation of gamification mechanisms and elements are inadequately expounded upon in the majority of reviewed papers. Furthermore, only Dolly et al. in 2024 [7] delve into potential idiosyncratic variations in incentive structures (also observed by [9]). To comprehensively address these motivational factors, an in-depth understanding of what motivates individuals in sheltered workplaces is indispensable. This research gap is effectively filled by the following interview study.

5 Interview Study to Identify Gamification Mechanics

Designing successful gamification mechanics requires exploring the characteristics of the prospective users and of the environment. This requires being present on-site to study real work situations and discuss these observations with the prospective users.

The aim of the interviews was to understand what motivates people in sheltered workplaces to contribute to the improvement of their work processes. We inquired about their abilities to use technical devices and whether they would like to use them at work. We used a qualitative approach to reflect the diversity of skills and cognitive abilities of the employees.

5.1 Method

This section explains the interview method, the questionnaire, and the characteristics of the participants.

Semi-structured Interview. We developed a questionnaire to investigate the work environment and motivational factors. The interviews started with a warm-up consisting of a casual conversation about general work tasks. The main part of the interviews was conducted in line with specific types of work motivation, such as work environment, work characteristics, (social) support and trust. The interviews additionally encompassed questions concerning feedback processes and questions about the persons (e.g., experience with technology and technology acceptance).

Laddering. We used the laddering technique to derive the motives related to work engagement [10, 12, 27]. The laddering technique is used to understand customer motivations. It is a sequential method in which the interviewer poses a series of questions to the respondent, aiming to identify overarching meanings that influence the participant's perceptions [27]. Initially, interviewees were prompted to articulate their overall work motivation. They were then asked to explain the reasons for their specific motivation. Using this "probing" methodology, respondents ascend the "ladder of abstraction," reaching higher levels of complex constructs. In addition, participants were asked to list incentives that could motivate their respective feedback behaviors.

Participants. Participants were recruited from a large provider of sheltered workplaces. The participants embody a diverse spectrum of employees in terms of age, skill, and cognitive or physical ability. While one individual had recently completed their training, another was already of retirement age but continued to work. Among the respondents, two individuals were cognitively impaired, one psychologically, and one physically. All had been employed at the workplace for several years.

Analysis. The interviews were audio-recorded, transcribed, and analyzed. Each interview lasted between 20 and 30 minutes. Statements of the participants were assigned

to different motivational factors (e.g., achievement, affiliation, or power motivation compare, for example, McClelland's motivation structure [22]). Incentives for motivation to contribute to knowledge transfer were assessed as well.

5.2 Results

The main motivational factors in sheltered workplaces are intrinsic. People take pride in their contribution. Furthermore, the social relation to their peers and superiors is important. The following section discusses the results of the interviews.

Work Environment and Characteristics. Work processes in sheltered workplaces are standardized to maintain quality and respect the specifications by the customers. The diverse abilities of employees require a degree of standardization. This limits the space for employee feedback.

Processes are mostly performed in isolation. Only few workstations are directly connected to each other in a production line. This is necessary to reduce performance pressure. The work environment is also not very digitized. Displays or tablets are only present when it is required by the machinery that is being used.

Some employees are also deployed externally and work within other companies. Employees are especially proud of such tasks, as this demonstrates their ability. All respondents indicate a preference for engaging in more complex work processes.

Employees. Motivation. The interviews displayed a wide range of work motivations. While one individual exhibited high achievement motivation, performance pressure was a deterrent factor for others. Nevertheless, all participants take pride in their work, and they are motivated to come to work. It gives them meaning and a purpose. This was despite the high diversity in age, experience, and cognitive ability.

Social Relatedness. All participants expressed that the social factor is critical to their job satisfaction. Being surrounded by colleagues and having opportunities for social interaction is critical. Social interactions do not necessarily involve work-related topics but are also related to casual interactions. However, the desire of the people for social interaction varies greatly. The relationship with their team leaders is also critical.

Technological Acceptance. Most participants expressed that they would accept technological assistance within their work processes. *Degrees of independence.* People have various degrees of independence. Some commute to work over longer distances. Monitoring during work is not very close after people have learned a task.

Goals and Supervisor-Feedback. Depending on cognitive capacity people set and pursue their own goals ("Today I want to complete xxx pieces."). Interviewees adapt the goals to their level of performance on a given day and time. All respondents reported feeling proud when they achieve goals set by their superiors or goals, they have set for themselves.

A significant motivational factor is feedback from supervisors. Participants enjoy being trusted to do their work correctly and rely on the regular feedback from their team leads to judge whether they have done a good job.

Knowledge-Transfer-Processes. Despite the standardized work processes, employees, depending on their cognitive abilities, are motivated to share their ideas for improvement. Some aim to enhance efficiency, while others wish to demonstrate their competence. Explaining the processes and how they are related with each other is critical to help people understand why some processes “are the way they are”.

Interview Method. The laddering method was only partially applicable to individuals with cognitive impairments. This was due to the limited abstraction ability of the participants of the interviews. Therefore, a more individualized approach to the interview will be evaluated.

Studies in Further Environments. We also wanted to see if we could find similar motivations among employees in sheltered and non-sheltered workplaces. The more intrinsic motivations found in this study, such as social relatedness or the recognition from peers and the team leader, may be less present in non-sheltered workplaces. The role of extrinsic motivations, such as pay, may be greater in such environments.

6 Gamification Mechanics

The gamification mechanics focus on social relatedness and individual development. These motivations were identified as key motivations in the interview. Competitive mechanics, such as points, badges, and leaderboards, would be inappropriate since a sheltered environment should be characterized by the absence of performance requirements and competition. Furthermore, the abilities of employees of sheltered workplace are diverse and their motivation may vary significantly throughout the day. Therefore, achieving goals and competing with peers would create performance stress, which is not desirable.

6.1 Positive Leaderboards

In some games, the goal is to "be the best," "keep up," or simply "win," which refers to being at the top of the leaderboard. In sheltered environments, such comparisons are inappropriate, as competition among non-competitive people leads to frustration and disappointment. Instead of a leaderboard that compares and displays individual performance, a dashboard could positively quantify a team's performance. The aim is to show how the performance of a team contributed to a larger aim. Some examples are presented below.

- Team A has provided blinds to 52 houses this month.

- Team B has packaged beans to brew 20k cups of coffee today.
- Team C has renovated the interior of 50 train wagons interior this month and over XYZ passengers will appreciate your work



Fig. 1. Possible implementation of the positive leaderboard.

The results may also be supplemented by videos. Such videos could show how, for instance, blinds are used in buildings or homes. Explaining how small steps fit together and in what products they are used can motivate employees and make small and simple work processes more meaningful.

6.2 Avatar Editor

Avatars allow to have a personal presence in the virtual world of the application. Being able to customize their avatar to their liking makes players feel more connected to the application.

It is important to consider the diversity and inclusion when designing avatars in gamified applications. If avatars represent only a limited range of genders, ethnicities, or abilities, many users may feel excluded or unrepresented. An easy way to provide diverse avatars without creating a complex editor would be to abstract users to colorful shapes with faces (see **Fig. 2**).

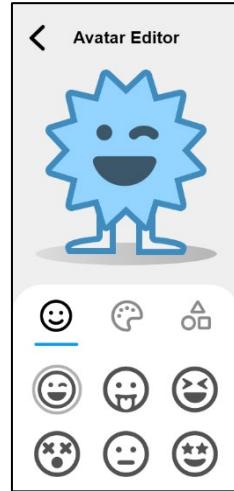


Fig. 2. Possible implementation of the avatar editor.

All users start with the same set of shapes and faces. Additional shapes and faces may be offered as a reward for something (e.g., personal progress or for Christmas). These additional shapes may be seasonal (e.g., fir tree, ice cream cone, or leaf).

Avatars also provide a mechanism for users to display or visualize their current situation and emotional state. Making the avatar available to team leaders could help them support their team members and organize work processes accordingly. Avatars can also be displayed to colleagues based on the preferences of the individual employee, for instance to indicate a desire for social interaction.

7 Conclusions and Further Work

The study presented in this paper provided gamification mechanisms for application in continuous improvement processes. The development of the mechanism was based on an exploratory literature review and a qualitative interview study. The motivations are mainly based on intrinsic factors such as social relatedness and less on extrinsic factors. These insights are crucial in designing gamified interfaces that resonate with users' psychological motivations, thereby enhancing their engagement and satisfaction.

A workshop to evaluate a first set of prototypes with people with cognitive impairment is planned. We expect that working with concrete prototypes will better address the limited capacity for abstraction of people with impairments. Further interviews in non-sheltered workplaces are planned to evaluate whether similar gamification can be applied to such environments.

Extending our research to non-sheltered workplace environments allows to examine the scalability and adaptability of our gamification approach in more diverse settings. This expansion is critical to understanding the universal applicability of our findings and to tailoring gamification strategies to various work environments.

This paper not only contributes to the theoretical framework of gamification in human-computer interaction but also paves the way for practical applications that are inclusive and engaging. Future work will continue to implement the gamification mechanics identified in this paper.

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Table 1. Results of the Literature Review

Article	Industrial context	Gamification mechanics / dynamics	Gamification elements	Method	Psychological output
Dolly et al., 2024	Assembly task in manufacturing and production	Progress bars, goals, strategy, time constraints, increasing complexity, loss aversion, achievements, and awards	Displaying performance, badges, rewards	Experiment, between group design, N=20 university students	Significant effect on the perceived workload, an increase in mental demand, physical demand, temporal demand, effort, and frustration
Dvorak et al., 2023	Learning factory during an assembly step		Levels, badges, pop-ups, statements	Experiment between group design, N=22 people from university environment	Higher motivation to work faster in the gamified rounds, due to the higher level of competition that the participants perceived (accompanied by more fun and identification with the execution of the task; pressure also)
Keepers, Nesbit et al., 2022	Manufacturing operations in industrial settings	Feedback, levels, progress bars	Leaderboards, points, badges,	Literature review	motivation
Tayal, et al., 2022	Supply chain management	Progress	Points, leaderboards	Literature review	Employee motivation in tedious work
Sochor, Schenk et al., 2021	Production and logistics	Production and logistics	Levelling system, trophy shelves, countdown timers, daily quests, performance graphs, fictional scenario, customizable avatars, open-world narrative; Epic Meaning and Calling; development and accomplishment; empowerment of creativity, ownership and possession, social influence, scarcity and impatience, unpredictability and curiosity, loss and avoidance	Experience Points, anonymous leaderboards, employee of the week, traffic light smiley, pick-by-light system	Conceptual development of a gamification configurator for production and logistics
Ulmer et al., 2020	Validation in longboard production	Feedback, competition, cooperation, win state, rewards, achievements, quests, levels,	Points, teams, leaderboards, badges, skills, challenge	Conceptual development of a gamification framework for manual work combined with a case study for validation	
Warmelink et al., 2020	Logistic, production	Objectives & goals, multimedial feedback, metaphorical or fictional representations, levels, achievements, progress	Points,	Literature review	Anticipated outcome: Increased motivation

Kom et al., 2019	Student Experiment with simple redundant assembly task (10 colored Lego house assembling)	Feedback, progress and score	Time	Exploratory experimental research N=23 (19 students & 4 trainees)	Significant higher joy in gamified group; gamified group stays in constant arousal while the other group drifts toward boredom; shows also more anger
Stadnicka & Deif, 2019	Acquisition of knowledge concerning lean manufacturing concept implementation	Lean games characteristics: subject lean manufacturing, incorporate lean tools, require teamwork, different complexity, require similar number of participants	N=114 (students and workers from Poland and USA) Game play with surveys concerning motivational processing, cognitive and social processing knowledge test t0/t1		The game play increased attention, relevance and satisfaction as measured motivational outcomes in t1
Tsourma et al., 2019	Factory shopfloor	Rules, actions, levels, awards, achievements	Points, icon (badges)	Conceptual work for industry 4.0	Expected Impact: Increasing user motivation and participation in knowledge sharing and training
Liu, Huang et al., 2018	CNC machine operations in manufacturing	Competition, feedback, achievements,	Points, badges, leaderboards, challenge	Experiment with between group design (N=60)	Increased job motivation and satisfaction through smartphone-based gamified job design
Lee et al., 2016	Automotive assembly line	Concrete goal and purpose; direct feedback of task performance & current progress; Empty cookie fill, set lottery number based on task performance (points exchange), exploration tour in exchange for task performance; virtual Pinata, balls to throw in exchange with task performance; match against selected opponent		Conceptual work with prototype testing (storyboard presentation)	Gamified interfaces provide higher motivation and a playful experience
Roh et al., 2016	Bolt tightening experimental condition	Gradual goal setting and feedback design; epic meaning through badges; Reactive audio-visual feedback, progress bar feedback, overall score through badges (trophy, medals, or stars); short / medium and long-term gamification		Explorative experimental setting N=5 (age 25-27)	Excitement level and worthful emotion increased
Kom et al. (2015)	Assembly processes in sheltered workplaces	Goals & objectives, multimedial feedback, metaphorical or fictional representation, levels; Color of a pyramid step as progress, as error-indication; Pyramid board as qualitative feedback place		Literature review and prototype testing, N=24 impaired people in a sheltered workplace	Task satisfaction, motivation and positive emotional state increased with the game

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