Gamification models
based on Gardener Classification

Within the e-Close Project

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Introduction

Within IO4 of the e-Close project several gamification activites took place and were combined with the Multiple Intelligence Theory of Gardener.

In their search for ways to improve teaching, the project team have come across the methods of Howard Gardner for multiple motivation (Gardener 1983 p. 60f; Gardener 1993; Gardener et al. 1996). This report briefly presents the methodology and discusses the motivational impact of the adapted approach. Furthermore, it should describe how the approach of Multiple Intelligence Motivation was adapted within the project. The theory of multiple intelligences was developed or let us better say observed by Gardner in the early 1980s because he believed that classical intelligence tests were insufficient to identify and appropriately promote abilities that determine success in life in different cultural settings or occupations (Gardener 1993; Gardener et al. 1996).

From this theory, Gardner developed suggestions for how schools or institutions of higher education should teach and nurture students' abilities. In the past, because Gardner's theory does not stand up to empirical scrutiny, it has been often rejected by scientific intelligence researchers like Weber, Rost, and Süß (Rost 2009p. 112ff; Weber, Westmeyer 2001; Süß, Beauducel, 2011). Nevertheless, because of this criticism, the method seems to fit very well to solve several problems, which occur during the last two years of online homeschooling caused by the current pandemic restrictions and circumstances. A rise of resistance against online learning could be observed. If there exists multiple intelligence it should be possible to expand this attempt to a broader field of multiple motivation. Because motivation is the driver for the development of intelligence and fun is the key for lifelong learning.

To address all the different intelligence types of students, a solution for an appropriate teaching method during online classes is needed. Gamified tools usually stimulate different senses.

To get the students' attention the topic of the blended exchange programs within the project is Gamification. New methods are tested from students and teachers' point of view. The gamified teaching allows the students to keep motivated and the teachers to keep their teaching up to date.

Gardeners Types of Intelligence

The theory of multiple motivation is not new and was used in several ways especially in the 1980s. However, can be seen in a new light in combination with the lack of motivation during the pandemic homeschooling and the decrease of stimuli. Howard Gardner understands intelligence as several abilities and skills that are necessary to solve real-life (genuine) problems or to overcome difficulties in a certain cultural environment. This includes the ability to recognize new circumstances and thus lay the foundation for the acquisition of new knowledge (Weber, Westmeyer 2001).

From a review of evolutionary theory, the study of so-called savants (people with insular gifts), and from the study of historically outstanding talents such as Einstein, Picasso, Stravinsky, or Gandhi, Gardner developed his concept of multiple intelligences, which he then expanded to include additional abilities (Süß, Beauducel, 2011). The first eight published types of intelligence can be described as follows:

Linguistic intelligence
Linguistic intelligence includes sensitivity to spoken and written language, the ability to learn languages, and the ability to use language for specific purposes. Successful lawyers, orators, writers, and poets are among those with high linguistic intelligence.

Logical-mathematical intelligence
Logical-mathematical intelligence includes the ability to analyze problems logically, perform mathematical operations, and investigate scientific questions. Mathematicians, logicians, programmers, and scientists make use of logical-mathematical intelligence.

Musical-rhythmic intelligence
Musical intelligence means the aptitude for making music, composing, and sense of musical principles.

Pictorial-spatial intelligence
Spatial intelligence includes the theoretical and practical sense, on the one hand, of the structures of large spaces to be grasped, for example, by seamen and pilots, and, on the other hand, of the more narrowly defined fields of space important to sculptors, surgeons, chess players, engineers, graphic artists, or architects.

Physical-kinaesthetic intelligence
Bodily-kinaesthetic intelligence contains the potential to use the body and individual body parts (such as the hand or mouth) to solve problems or design products. Representatives of this intelligence are dancers, actors, and athletes. However, this form of intelligence is also important for craftsmen, surgeons, mechanics, and members of many other technical professions.

Naturalistic intelligence
Naturalistic intelligence includes the ability to observe, distinguish, recognize, and develop a sensitivity to natural phenomena. This ability is important for naturalists, environmental specialists, veterinarians, and cooks.

Interpersonal Intelligence
Interpersonal intelligence has been called the ability to empathically understand even unspoken motives, feelings, and intentions of others and to influence their moods and emotions. This ability is an essential prerequisite for successful interaction with other people. Gardner sees these abilities as particularly strong in political or religious leaders, in skilled parents and teachers, and other counseling

or healing professions. Interpersonal Intelligence is better known as Social Intelligence according to Wechsler (Dahl 1965).

Intrapersonal intelligence

Intrapersonal intelligence is the ability to understand and influence one's feelings, moods, weaknesses, drives, and motives. According to Gardner, these individuals have an accurate mental model of their personality that helps them anticipate their behaviors in various situations. Gardner means this internal, self-knowledge-based, helps people make correct decisions.

Interpersonal and intrapersonal intelligence are the basic building blocks of the theory of emotional intelligence as developed by Mayer and Salovey and later popularized by Goleman (Mayer, Salovey, Caruso 2002). Intrapersonal intelligence is particularly pronounced in writers, actors, and artists and has therefore a strong connection with the reactance and the ability to handle demotivation.

In addition to these eight forms of intelligence Gardener has identified, a further ninth, existential intelligence or spiritual intelligence, which is concerned with fundamental questions of existence. Representatives of this potential intelligence would be, above all, religious and spiritual leaders or philosophers.

Gamification in education

Gamification methods are adopted for techniques used for education and in professional training. Gamification in education has been a rising topic for at least seven years, because of the fast growth of publications in that area (Swacha, 2021, p. 13). The following figure gives an overview of the main words appearing in the context of gamified education.

Word Cloud combining different studies (Caponetto et al., op. 2014)

Taking a closer look in the areas that use gamification in education about 1/3 of the publications are in the field of Computer Sciences, followed by Social Sciences (about 1/4th), Engineering (about 1/7th), and Mathematics (about 1/14th) (Swacha, 2021, p. 9).

To clarify the term gamification Caponetto et al. (op. 2014, p. 53) found out that 75% of the papers use the term gamification "to refer to situations in which the learning path in its entirety is treated as a globally "gamified" process". Some use gamification as a term to "relate to cases where learner interaction with a Serious Game has been integrated to some extent within a global learning intervention that is gamified". Only nine percent of the sample used gamification as a synonym of game-based learning. (Caponetto et al., op. 2014, p. 53)

Game-based learning is a method that adopts games for educational purposes and gamification applies game mechanisms to educational interventions (Caponetto et al., op. 2014, p. 55). These two concepts remain sufficiently distinct. Both are used a lot and sometimes even combined they can nurture each other. Overall Gamification techniques are used to make learning in education more attractive and motivating. It supports the collaboration, creativity, and self-guided study of students (Caponetto et al., op. 2014, p. 55).

Nah et al. (2014) figured out eight elements of game design that are used in educational and learning contexts. Points, levels, badges, leaderboards, prizes, progress bars, storyline and feedback are the main elements. The point system allows teachers to measure the success of the students. In an academic context they can be considered as credits also. Secondly various levels/stages allow learners to get a sense of progression in the game. With each stage the level of difficulty rises, so students increase their skills with each level. Thirdly badges are another element. They are rewarded when a task is accomplished and motivate the learners to keep engaged in the classroom. Badges also inspire learners to work towards future goals. Furthermore, leaderboards are used to show the current high scorers of the game. Students' sense of eagerness and competition is risen by that and is one of the most motivating elements for learners. Prizes and rewards are another element which is effective to motivate learners. Additionally progress bars are a commonly used element in educational games. They display the current learning progress and motivate students to achieve their educational (sub-)goals. If a student is falling behind in his learning progress, progress bars can encourage him to

continue learning. Another element which helps to keep students interested during the learning process in the game is a storyline. The game should be narrative and helps students to transfer the learned subject into real-life. Especially for problem solving activities a storyline is useful to keep students motivated. Finally, feedback is the last element which increases learner engagement. It is important to give frequent and immediate feedback because it has a greater influence on the learning effectiveness and keeps the students in the flow state. (Nah et al., 2014)

Overall, Gamification methods increase the student's motivation (Hassan et al., 2021; Monterrat et al., 2015), even though "a big effort is required in the design and implementation of the experience" (Domínguez et al., 2013, p. 391).

WBS Learnspace 3D

The WBS LearnSpace 3D is a virtual learning and working world which allows students and teachers to come together on a virtual campus (WBS TRAINING AG). It is a software tool of the WBS Akademie, which is a new German education business. They offer training courses, open seminars, and further education to increase the career opportunities of workers. They specialized in digital learning and were awarded the eLearning AWARD 2018, the Digital Champions Award, and the HR Innovation Award.

With the WBS LearnSpace 3D® a virtual simulation of a learning environment can be offered to the students. It enables teachers and students to conduct digital seminars and lectures in their virtual learning world. A virtual house, branded with the university logo, brings students and teachers on a virtual campus together, either in the house, on the terrace, or in the parking lot.

For international seminars, the e-Close Academia gives students from different nationalities the chance to come together online, no matter where they are located. The WBS LearnSpace 3D makes global digital collaboration an experience. With an individual avatar, participants move around in a building with a lecture hall, seminar rooms, and offices and communicate and interact with each other.

At the beginning of the first lecture on the virtual campus, the students got an introduction to how to get along with this software. When participants enter the house, they are placed in the foyer and can walk around. To find the auditorium where the lectures take place, they either walk the stairs or use the elevator to get to the second floor. After arriving in the auditorium, each student can choose his or her place on his or her own. It was possible to use individual clothes, characters, or even different sexuality. Additionally, during the lectures, even 3D models could be used for visualization.
The tool enables that 3D models can be presented in the middle of the auditorium. You can turn the object, so that you have a realistic view, how this model will look in reality.

The following table shows how the virtual campus addresses the different intelligence types:

Linguistic	PDF documents in the library
Logical-mathematical	Pools, whiteboard for calculations
Musical-rhythmic	Outdoor sounds (birds), clapping
Pictorial-spatial	Presentations, 3D models
Physical-kinaesthetic	Walking around, gestures of avatars
Naturalistic	Trees, Plants
Interpersonal	Talking to fellow students in meeting rooms/ lounge
Intrapersonal	Control over own avatar
(Existential/ Spiritual)	Places to relax

C1 – Gamification Workshop in Lodz

For 5 days students took part in activities with STEM (*which stands for: science, technology, engineering and mathematics*) teachers at the Technical University Lodz (teachers from partner universities could be also involved); new didactic methods and IT tools were implemented. These methods and tools included: individual work (e.g., presentations, mini PBL), teamwork (e.g. jigsaw, STAD), discussions (e.g. fishbowl), learning insights (e.g. high five).

Each day, students had one morning and one afternoon session. At each session, they were introduced to one method/tool. The topics of the days were the following:

- **Day 1**   Short challenges. Discovering some solids and surfaces – GeoGebra and AR to visualize them
- **Day 2**   Introduction to mern app development
- **Day 3**   Theory of Inventive Problem Solving
- **Day 4**   Applicability of various active learning methods in engineering
  A large variety of different active learning methods was used on day 4. Design Thinking, a kind of jigsaw combined with pantomime/sketching, a quiz and various kinds of brainstorming methods were used on that day.
- **Day 5**   Games that can be used in a language class
  Day 5 of the event was all about language games. Students had hands-on practice with them. In a project team activity (the main task of the day), they also designed their own game focusing on the DT persona and ideation. The game was then presented and assessed by other peers playing the role of end-users. Word, Picture, and People SMARTS were awarded to those of the teams that were most successful with language use, visuals, and people/communication skills.

On the fifth day, a summary session was organized, during which students gave feedback through whiteboard sketches on the usefulness of each of the gamification methods presented during the training in Lodz.

During the week, students were included in the city game, which allowed them to get to know the university campus and the city of Lodz better.

The following table shows how the Gamification Workshop in Lodz addressed the different intelligence types (Numbers show the workshop day):

Linguistic = Word Smart	*Łódź City Game:* *-communication „in the kitchen"* - EFL, active listening, providing constructive feedback, presentation skills (5)
Logical-mathematical = Number Smart	*Łódź City Game:* *-estimating volume/surface of real architecture elements* - identifying surfaces and solids and their formulas (1) - the most creative group (public voting) (2) - the most challenging problem (public voting) (2) - tech support (who prepared mockups) (2)

	• matching the concepts with the method (3) • competition in development of a solution to a selected engineering problem (4)
Musical-rhythmic = Music Smart	*Łódź City Game:* *-recognizing/playing/singing finding „music place"* • good explanation of the given term (using pantomime/song/drawings) (3)
Pictorial-spatial = Picture Smart	*Łódź City Game:* *-identifying 3 of 5 places on TUL campuses* *- a group for identifying at least one of the murals* • preparing the best AR mini-project (public voting) (1) • the presenter (who presented) (2) • good explanation of the given term (using pantomime/song/drawings) (3) • creating mind maps visualizing core concepts related to a selected engineering problem (4)
Physical-kinaesthetic = Body Smart	*Łódź City Game:* *-"kitchen" skills* • good explanation of the given term (using pantomime/song/drawings) (3)
Naturalistic = Nature Smart	*Łódź City Game:* *-„kitchen products" knowledge*
Interpersonal = People Smart	*Łódź City Game:* *-identifying 4 of 5 places on TUL campuses* *-a group for finding an exact place* • the best peer-tutor (group voting) (1) • the biggest influencer (which problem is taken) (2) • Teamwork (1-5)
Intrapersonal = Self Smart	• presentation of the game, reflection on own work (5)
(Existential/ Spiritual) = Life Smart	*Łódź City Game:* *-identifying 5 of 5 places on TUL campuses* *-a group solving at least one of additional tasks*

Each day a group with the greatest number of SMARTS could choose small awards. Finally, the SMARTEST group was awarded.

C2 – Gamification Workshop in Saarbrücken

The on-site gamification workshop in Saarbrücken, Germany provided a space with new activities and a scope to discuss online activities and distinguish the leaders of the entire process.

During 5 days in Saarbrücken, students took part in activities with teachers from the University of Applied sciences Saarbrücken; new didactic methods were implemented. These methods and tools included: individual work (e.g., presentations), teamwork, discussions, learning insights.

The whole week had the topic "Develop your own wind turbine to produce hydrogen". The days were structured as follows:

- **Day 1**   Introduction and building teams, presentation of online work
- **Day 2**   Lectures about the theory of *fluid dynamics*
- **Day 3**   Wind turbine workshop (construction of axial wind turbines)
- **Day 4**   Hydrogen production, preparation of presentations
- **Day 5**   Presentations, awards

During the five workshop days students learned in some lectures the basics about windmills and fluid flows. On the next day students had to draw and then construct the blades themselves. Wooden materials as well as different foils were offered, and students could decide on their own which material they wanted to use and how they shaped their blades. They saw, cut, hone down, glue the materials and in the end, they had to have three blades done. On the next day the windmill with their blades was connected to a hydrogen cell and a constant wind turbine was switched on in front of the mill. The amount of hydrogen production was measured, and the winning team was awarded a trophy.

As a social program during the week students did a treasure hunt with the app actionbound. The students divided into groups and each group used one smartphone. They had to fulfill different tasks like taking a selfie, singing a song etc. to unlock the hint to explore the next sight of the city.

On the fifth day, a summary session was organized, during which students held their final presentations and gave feedback on the workshop.

C2 – Gamification Workshop in Saarbrücken

The following table shows how the Gamification Workshop in Saarbrücken addressed the different intelligence types:

Linguistic	Communication among the teams (English as a foreign language), presentations
Logical-mathematical	Calculations about efficiency of windmills
Musical-rhythmic	Treasure Hunt Task
Pictorial-spatial	Technical drawing of the blades
Physical-kinaesthetic	Build blades (cut, saw, file, glue)
Naturalistic	Renewable Energy (electrolysis of water to separate hydrogen from oxygen)
Interpersonal	Teamwork
Intrapersonal	Presentation, reflect/criticize the own work
(Existential/ Spiritual)	Humans need energy. Thinking about renewable methods.

C3/4 – Badges of the Mazury Camp

The summer school was a part of implementation of the award of digital badges (micro credentials) for confirmation of students' skills. As the idea of digital badges comes from scouting, students from partner universities were invited to a one-week survival camp simulating scout-like activities. They earnt badges by carrying out various types of tasks developing soft skills. Academic teachers provided adequate support and learned how to award the badges in practice. The event took place in the Masurian Lake District, at one of TU Lodz' facilities.

Participants: 5 academic students of each university plus at least one staff member of each university

The main results of the activity were the increase of soft skills of student competences for Sustainable Development Goals.

The following table shows how the Marzuy Camp addressed the different intelligence types:

Linguistic	EFL; 3-level system: level 1 – storytelling; level 2 – presentation; level 3 – pitch
Logical-mathematical	Level 1: flowchart, Level 2: usage of basic Socratic questions and tortuous logic, Level 3: usage of socratic questions to find the answer
Musical-rhythmic	Shanties singing (competition of nations)
Pictorial-spatial	Level 1: simple mind maps – discovery of engineering concepts, Level 2: navigation case study – visual representation of spatial relations, Level 3: conceptualization of innovative ideas/solutions
Physical-kinaesthetic	Level 1: basic sailing knots, Level 2: preparing the yacht for the cruise, Level 3: navigation and sailing
Naturalistic	Level 1: creation of a team totem and storytelling, Level 2: nature watching (birdwatching journal), Level 3: herbarium adventure storybook
Interpersonal	Teamwork, „Setting up the camp", "kitchen watch"
Intrapersonal	Reflecting on own work

Conclusion

This report has shown that the blended mobility module about gamification gave students the chance to meet with international fellows and experience a gamified workshop which motivates to learn and to work in teams. This exchange program of the e-Close project was a success and can be seen as an inspiration for other international university networks to implement blended exchange formats with gamification.

The gamification workshops give all kinds of students the opportunity to get to know other countries/cultures, work in international teams and broaden their learning experience in a short time. Virtual campuses are fun to use and help to bring students and teachers from different universities together.

Different Intelligence Types can be addressed in all workshop formats and therefore help students learning.

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