Motivation in Game-Based Learning: It's More than 'Flow'

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Abstract: Educational computer games are sometimes considered to be motivating per se – because of the playing activity - and do not require further motivational strategies. Therefore the concept of 'flow experience' is commonly used to describe how smooth gaming naturally results in deep engagement and, consequently, enhanced learning. Learning with an instructional game without discovering the instructional parts, seems to be a crucial goal considering the presumed needs of today's digital natives. However, teaching factual knowledge and the need for educational guidance, assessment and other intrusive components impede the creation of a free flowing educational game in contrast to non-educational games. The present paper claims, that an exclusively activity-focused view on game-based learning lacks important aspects of motivation on the basis of a broad motivational theory and a game model of motivation. Those aspects include personal and game characteristics, usability issues as well as anticipated outcomes. An integrative model of game-based learning is introduced and the theoretical considerations are transferred to the realization of a demonstrator game in the context of the European research project 80Days.

1 Introduction

Learning by playing a game is a natural as well as an ambitious thought, which attracted much attention of scientific publishers especially in the last decade. Educational games are considered to fulfil the needs of today's children, who are born and raised in between digital technology. As a result of being so called 'digital natives', children are used to the instantaneous availability of any information they want, and therefore do not have the patience required for traditional learning like lectures and classes, which commonly follow a step-by-step and tell-test logic [P01, P05]. Further, the assumed change of how contemporary children think and process information, forces a fundamental revision of the existing educational methods, which are no longer appropriate for these children. They should learn more effective from instruction in a game format, which provides them with "...desirable goals, interesting choices, immediate and useful feedback, and opportunities ... to see [themselves] improve..." [P05, p. 11]. By this means the child will learn while playing the game without really noticing it. Although the idea of a new distinct generation of children with completely different thinking styles and educational needs, is not without controversy [BMK08], the approach of using the appealing features of games to achieve more engaged and motivated learners remains very delightful.

That is the reason why numerous researchers and projects nowadays are concerned with the topic of game-based learning, as it is the case for the EC-funded project 80Days (www.eightydays.eu). The project is running from 2008 to 2010 and inspired by Jules

Verne's novel "Around the world in eighty days". In the course of the project an educational game will be developed (in three development phases), dealing with geographical contents and targeted for 10 to 14 year old children. Hereby, game design considers among other things current motivation issues in game-based learning. This paper essentially presents the background of motivational interventions and strategies for the first demonstrator game developed in the project. This theoretical basis will be adjusted and refined in the further course of the project, and can therefore be seen as a starting point for a work in process.

2 Motivation to Play and Flow Experience

Game-based learning can be seen from two different perspectives - the learning and the gaming perspective – and consequently, the motivation to use an educational game depends on the motivation to play the game and/or on the motivation to learn about the related domain. Since the motivation to play is the crucial advantage of game-based learning over traditional instruction, it is only natural that researchers frequently focus on this motivational component as a key aspect of instructional games. Motivation to play is strongly related to the motivation grounded in activity-specific incentives, for which the concept of 'flow experience' [C92] is a prominent ambassador. The term 'flow experience' refers to a state of full immersion in an activity, which typically goes along with a loss of sense of time and no reflection on carrying out the action. The appearance of this 'optimal experience' is likely while interacting with a computer and perceived very positively [K05a]. Further the antecedents of a flow experience allow the deduction of some potentially useful game design principles [K05a, R06], which enhance a focused attention and immersion of the player:

- The *challenge* of the game should fit the ability of the player; otherwise she would experience either anxiety or boredom instead of a 'flow'. By this means the player has the feeling of *controlling* the situation.
- The *goals* to be achieved should be clear at any point of the game, so that the player always knows what to do without exerted thinking about it. Also the provided *feedback* should be clear, appropriate, and immediate.
- The instructional game should be *playful* and composed of an action procedure, which is experienced as *fluent*. A good *usability* avoids that the player spends cognitive resources for inappropriate actions.

The concept of flow experience seems to be very fruitful in game-based learning and attempts to create 'flow-based' educational games [K05b] were quite successful in inducing a flow experience and enhancing learning. However, some researchers in the field of e-learning did not find evidence for a relation between the appearance of a flow experience and the learning effect [KFH03], so that a clear relationship probably cannot be stated [SR97].
Beyond that, it is questionable if some characteristics of educational games, which differentiate them from conventional games for entertainment, impede the appearance of a flow experience (or generally immersion) dramatically. Castell and Jenson [CJ03] state that "education has not been able to realize the immersive possibilities of new digital resources..." and point out two weaknesses of existing educational games. The authors claim the necessity to connect game-play elements with the learning content (compared to a series of tasks integrated loosely in a game narrative, but with no direct connection), and to provide the players with the possibility for boundless navigation and movement (instead of a rigid structures of learning elements).

These claims obviously relate to the learning approach of learning-by-doing or explorative learning. One important question in this context is, if all kinds of instructional content can be integrated in such an explorative game. Procedural knowledge seems to be especially feasible to be provided within a gaming scenario, because knowing how to do something can be properly explored and acquired in a playful environment. The creation of an instructional game, which administers the knowledge of facts, may require somehow more effort to assure a flowing, boundless explorative game play, because this knowledge has to be taught frequently by telling and not by free exploration only. All types of educational games, but especially games dealing with factual knowledge, need more or less intrusive methods of assessment and adaptation, because the knowledge commonly cannot be observed simply through the behaviour in the game. After all, playing and learning/working remain somehow different concepts, because latter not always is voluntary, non-productive, and separate from the real world [GAD02]. Consequently, it is arguable if specific characteristics of instruction make exclusively flow-oriented motivational strategies insufficient in the field of game-based learning. As a result, for a successful and intelligent design of educational games, a more comprehensive reflection and consideration of motivation and learning processes is necessary.

3 Further Motivational Aspects

As we have hypothesised, to enjoy the activity of playing because of a flow experience, to immerse and engage in this activity and to consequently get equipped with the instructional content the game includes, is an essential but not the exclusive motivational component of game-based learning. To supplement this approach with further aspects of motivation two selected models are presented, which should, together with the concept of 'flow experience', incorporate to a more suitable game model of motivation.

3.1 The Expanded Cognitive Model of Motivation to Learn

The expanded cognitive model of motivation to learn [HH06] is a very comprehensive model in motivation psychology, which claims to include multitude aspects of 'motivation and action'. Although it is a general model, which has no focus on game-based learning, it is useful to go ahead towards a more complete model of instructional games and motivation. The model describes different aspects involved in a learning situation [R06, HH06]:

- The structure of an action episode: the interaction of a person with a situation leads to an action with an outcome, which has specific consequences.
- Different expectancies of the learner connecting the structure elements: the person has expectancies about the result of the given situation without accomplishing any action (situation-outcome expectancy), about the outcome of a specific action (action-outcome expectancy), and about the consequences of this outcome (outcome-consequence expectancy).
- Incentives of specific structure elements: activity, outcome, and consequences can have an incentive – the authors describe the first two incentives as intrinsic, whereas the thirds is considered to be extrinsic.

This cognitive model considers the concept of 'flow experience' as a possible activity-specific incentive. The complexity of the model allows a sophisticated view on motivational aspects of a general learning situation, and consequently on possible starting points for motivational interventions. The model suggests that besides the playing activity itself, also personal characteristics like motives, interests and expectancies, as well as the outcomes and consequences should be an issue in game-based learning.

3.2 Input-Process-Outcome Model of Instructional Games

The input-process-outcome model of instructional games [GAD02] describes the learning process of a person with an educational game, and summarizes many important aspects of prior research [C92, B77, K87, M81]. In the model the input consists of the instructional content and six game characteristics of an effective instructional game (fantasy, rules/goals, sensory stimuli, challenge, mystery, and control). The integration of the instructional content in the educational game produces a repeating game cycle of user judgements, user behaviour, and system feedback. Playing the game forces the user to judge about how fun, interesting etc. the game is. These judgements determine the direction, intensity, and quality of the behaviour. Finally, the system provides the learner with a feedback regarding her behaviour, which triggers again a user judgement. A debriefing process, within which events that occurred in the game are reviewed and analyzed, links the game play to the achievement of learning goals.

4 Integration to an Advanced Model of Motivation for Educational Games

A closer look on the two models discloses a similar structure - regarding a precondition-action-consequence-chain - but with different emphases. Whereas the input-process-outcome model neglects characteristics of the person (like interest) and her expectancies, the expanded cognitive model of motivation does not describe the activities within game-based learning in a specific matter. Therefore, the attempt to enhance the game model of Garris, Ahlers and Driskell [GAD02] with cognitive, incentive- and individual-related aspects of the expanded cognitive model of motivation to learn by Heckhausen and Heckhausen [HH06] should lead us to an integrative and enriched game model of motivation, which helps us to understand the underlying mechanisms. The following description can be seen as a fusion of specific elements of the two models, which are selected in terms of the assumed importance for motivation in game-based learning.

Basically, game-based learning consists of the three qualitative distinguishable parts conditions, activities, and outcomes. Conditions involve characteristics of the instructional content, the player, and the game itself, which have an influence on the activities of the person and the system, which in turn lead to specific cognitive and affective outcomes (see Figure 1). Each one of these parts can build an incentive for accomplishing the instructional game, and can therefore be used to enhance motivation. Further the user can have specific expectations regarding the activities and the outcomes of the activities, which also influence the motivation for playing/learning.

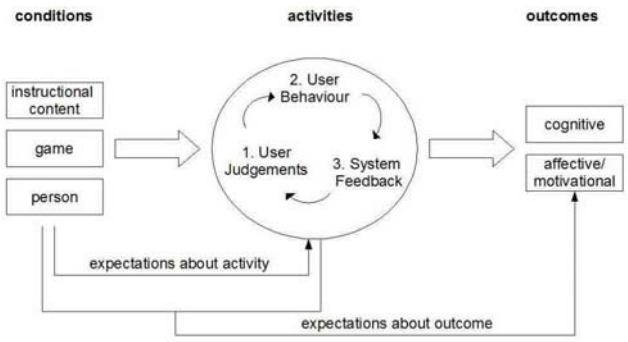

Figure 1: An advanced model of motivation for educational games.

4.1 Conditions

The conditions of a game-based learning situation refer to the input of the input-process-outcome model [GAD02], which consists of personal and situational variables [HH06]. These variables have to be properly considered for a successful game design. The nature of embedding instructional content within a playing context defines if the educational game is motivating for a specific person. Integrating various theoretical concepts in this one part of the model offers several approaches for motivational strategies, and a breakdown of motivational problems to a specific component of learning with games.

An instructional game can be appealing for a person, simply because she is *interested* in the instructional topic of the game. Such a person will be easy to enthuse, and will need no further motivational strategies to engage in the learning activity, because the incentive lies in the topic itself. Other personal characteristics (e.g. gender, motives, sensation seeking) could potentially influence the preference for a specific game play, and should therefore be considered in designing an educational game for a specific target group.
If a learner has no prominent interest in the instructional content, several game characteristics can be used to enhance her motivation all the same. There exist different collections of key characteristics of an enjoyable educational game. Two prominent examples, which also incorporated in the input-process-outcome model [GAD02], are Malone [M81] who considers challenge, fantasy, and curiosity and Keller [K87, K08], who stresses the importance of games enhancing attention, relevance, confidence, satisfaction, and volition. We would like to emphasize the three conceptions fantasy, confidence, and challenge, as three key concepts in the first demonstrator game of the 80Days project, and describe them a bit more in detail. To include *fantasy* in the learning process, e.g. in terms of a pleasing story, is one of the most crucial potentials of game-based learning. Fantasies are especially very effective to trigger interest in the instructional content by the interest in the fantastic game, when they are endogenous [R91], which means closely tied, to the content [cf. CJ03]. Another crucial game characteristic is to strengthen the player's *confidence*. A person will only be motivated to engage in an educational game, if she believes in a potential success. This depends partly on the person's trait self-efficacy-expectancy [B77], and can be influenced by self-worth enhancing motivational interventions based on the attribution theory [W74], which guide the player to attribute success to intern, and failure to variable factors.
A last feature of instructional games described here, is to provide the optimal *challenge* for a specific player. This means the difficulty of the game matches the person's ability in being neither too easy nor too heavy. To enable the ideal challenge the whole game through, it is necessary to continuously adapt the game to the person's current skills [KHA+08]. By this means the possibility of a 'flow experience' will be increased, and with an appropriate feedback the player will strive towards the desired goal.
A qualitative different, but nevertheless very important, game characteristic is a good *usability* to avoid discouraging the player, because of an inconsistent or non-intuitive game play. Some important points related to usability are to provide consistent and predictable game behaviour, allow skipping of repeated content, and support the person with instructions and help [PWS08].

4.2 Activities

All factors building the conditions of game-based learning define the expectancy of the player about her self-efficacy towards a successful activity, and also the activity/game itself e.g. in terms of fun. These expectancies result in a more or less appropriate initial user judgement about the game activity, before the playing has really started. The following user

behaviour causes a specific system feedback, depending on the characteristics of the game. An intelligent system will adapt the feedback to the user, to sustain or enhance 'challenge' and 'confidence'. Finally, according to the system feedback, the player will again judge her own enjoyment and confidence. If running through this activity cycle is pleasant, because of a flow experience or the perception of a progress towards a goal, the incentive of the educational game lies in the playing activity itself.

4.3 Outcomes

The game's conditions and activities produce a specific expectation about the outcome of the educational game in the person. If the player believes, that she can reach a specific outcome and finds this outcome very appealing, it is an incentive for her to use the game. Worthwhile outcomes of game-based learning could be to win the game, to learn about the instructional content, or a reward like money or a good grade.

5 The Case of 80Days

Motivational aspects can be addressed from two perspectives, the perspective of the learning game design (as a combination of typical game design with instructional design, which can be considered being more than the sum of its parts) and the perspective of the game's dynamic and intelligent adaptation to the motivational state of the learner. The approach to motivational aspects in game-based learning we have elaborated can be utilized for both, design and adaptive features of the game.

In 80Days a game demonstrator was developed that essentially teaches Geography for 10 to 14 year olds according to European curricula. A special challenge is teaching primarily factual knowledge – such as knowing European capitals – in a game-based approach. Consequently, it was crucial to establish a sound motivational baseline for the learning game design. This concerns a flowing game play as well as *endogenous fantasy* [R91]. 80Days tried to avoid isolated learning situations, simply enriched with some fantasy story and game elements, by a suitable and convincing narrative that integrates all learning elements to a meaningful (and attractive) whole. Within the game, the player is hijacked by an (allegedly) friendly alien named Feon, who needs skilled help in finding geographical information about the Earth to write a travel guide. To do so, the player can fly over Europe's landscape using Feon's spaceship. The well elaborated background story will be disclosed little by little while Feon and the player collect – and learn – facts about Western Europe.

To keep the player engaged and motivated, the game was made adaptive along the cognitive axes, by 80Days building upon the adaptation framework of *Competence-based Knowledge Space Theory* [AL99] and the recent extensions regarding micro and macro level adaptation for virtual learning environments [KML+08]. By this means the game is adjusting educational and gameplay challenges to the abilities and learning progress of the learner. Consequently the player is neither confronted with too easy nor too difficult tasks and therefore meets the optimal *challenge*. This approach goes beyond the concept of flow experience, because it provides a concrete procedure to adapt the difficulty to the available skills of a player. The presentation of challenging but manageable problems is also advantageous for the *confidence* of a player in her own efficacy. In 80Days a further adaptive strategy based on attributional training [DZ06] is used to enhance this important aspect for enduring and motivated learning by playing. These motivational interventions suggest, via a verbal feedback of the non-player character Feon, to see the cause of a success in internal variables – effort for novice and ability for more experienced learners – and to attribute failure to variable components of the learning situation, like the player's effort or bad luck. Thus, a success will strengthen the confidence of a learner, and a failure will not destroy

the motivation to continue, because the reason seems changeable either by increase of effort or simply a new trial.
The advancement of the educational game of 80Days in the next development phase will include additional motivational strategies and components according to a comprehensive model of motivation for educational games. Sophisticated evaluation methods will be applied to proof the success and effectiveness of game design and adaptive interventions during the game. So far, empirical studies yielded a strong acceptance of the game (story, gameplay, visual appearance, etc.), and a mainly satisfying learning effectiveness and usability.

6 Conclusion

The present paper endeavours to highlight sound motivational theories and their importance for successful educational games. While a convincing story and neat exploratory learning might be easy to realize, motivational theories are much more important when it comes to teaching factual knowledge. It is difficult to create motivating games based on the assumption that educational games can always transfer knowledge in a stealth mode, that is, without remaining undiscovered by the learner. The completion of the intrinsic motivation of playing by a sound motivational design and adaptation strategy allows designing more effective educational games, which do in fact not claim to be the same like commercial video computer games but which have their own distinct incentive.

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