Towards a Social Game Interaction Taxonomy

A Social Gaming approach towards Peer Knowledge Sharing and participation in Serious Games

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Abstract. *Serious Games for Learning* are often designed as singleplayer, storytelling-based games. Even though immersion into the story and adaption to the player's abilities are pedagogically well designed, players can have misconceptions or get stuck with game quests. Then they seek for assistance from friends or online. Accessing hints, solutions and help of others directly in the gaming context can improve the game play and learning experience. Additionally the users from *Online Social Networks* can be connected to the game as a valuable resource of know-how if they are provided with participation possibilities. The concept of *Peer Education* is valuable for teaching and assessment among peers with similar learning targets. Thus in this paper an approach towards *Social Serious Games* is presented. Existing *Social Media* interaction patterns and singleplayer, story-based game situations are brought together respecting the *Interaction Mapping Patterns 1:1* and *1:n*. The resulting three dimensional *Social Game Influence Taxonomy* is presented as well as the technical implementation as a middleware to connect existing *Serious Games* with *Online Social Networks* for *Peer Knowledge Sharing* and participation.

Keywords: Serious Games, Social Games, Social Learning, Peer Knowledge Exchange, Social Interaction Patterns, Social Serious Games

1 Motivation

Since ancient times games have been used for learning and training ("History of Games Timeline," n.d.). Social Games played by more than one player are used for knowledge transfer between individuals by means of competition or cooperation. In the last years *Online Social Games* became popular as they utilize the *Social Media* components of *Online Social Networks* (OSN) as interaction patterns between players during game play. If these interaction patterns are categorized and structured to specifically support assistance, guidance and help among users on one side (concept of *Peer Tutoring*) and the rating, assessment and quality control of creative, user-generated game content on the other side (concept of *Peer Assessment*) such a connection between computer games and *Online Social Networks* can be used to enhance the knowledge transfer, adaption and learning experience in *Serious Games*.

Currently most *Serious Games for Learning* (SGL) are for single players only and based on digital storytelling concepts in order to allow an adaption and personalization to the single player in the targeted knowledge domain. Speed of game play, flow of challenges and guidance as well as selection of events happens according to the player's needs. A maximum of immersion and minimum of frustration and hindrance is favored for the player's experience of gaming and learning (Chen, 2007). Still, such adaptation and flow control cannot perfectly match the player's needs because the computational model representation of player's learning, playing and assumed skills is a simplified abstraction. This results in situations during game play where additional information is needed by the player, a riddle is misunderstood and thus not solvable or the player has memorized misconceptions about the targeted learning topic and needs individual instructional support.

In such situations a player can benefit from human resources connected to his game play experience. It is the aim of currently ongoing research to connect the mentioned *Serious Games for Learning* to *Online Social Networks* and use the available *Social Media* for interaction between players and non-players.

The interaction types and kind of participation that can be used to connect OSN users to the player(s) of *Serious Game(s)* and vice versa is the focus of this paper. It presents the first version of a taxonomy about game situations in singleplayer, story-telling *Serious Games for Learning* and the identified interaction patterns for a connection to *Online Social Networks*.

2   Related work

The underlying work of this paper is inspired by the interaction patterns that are used by players of *Social Casual Games;* games that are casually played or with easy to use interfaces which are connected to OSNs (Loreto & Gouaïch, 2004). *Ines de Loreto* and *Abdelkader Gouaïch* identify *Asynchronous Play* as one important characteristic of such games. Players interact by e.g. exchanging items or favors, but do not have to be online or in the game at the same time. As *Nick O'Neill* states in his criteria list about Social Games, these games are mostly *turn-based* and *casual games* connected to OSNs, but still *Multiplayer* in a sense that there is an *awareness of others' actions in games* (O'Neill, 2008). We summarize these four criteria as *Casual Multiplayer*, which means a singleplayer game play, but multiplayer atmosphere due to asynchronous play and awareness – and thus interplay - of the activities of others. *Asynchronous Play* and *Casual Multiplayer* are a basis for the targeted *Social Game Interaction Taxonomy*.

A broader view to *Social Media* interaction patterns in general is given in (Crumlish & Malone, 2009). A somewhat simplified list focusing the interaction patterns between users of *Social Media* applications can be found at (Julien, 2011) and will be used in this paper later on.

Sociological analysis of interactions of individuals in their organizational and private social networks have shown the benefit of information exchange among peers; especially if they are not closely but weakly tied . Based on *Social Network Analysis* (SNA) this strength of weak ties is explained by Marc Granovetter in (Granovetter, 1973). That indeed weakly tied 'strangers' are willing to contribute information, assistance and help

depends on them consciously belonging to the same social group or having the same, non-competitive goals (Constant, Sproull, & Kiesler, 1996).

From a pedagogical point of view fostering the knowledge transfer between peers of a social group (e.g. classroom peers) is valued beneficial for personality and social competency development, learning by teaching, additional supplement to instructors teaching and provides individualized learning experiences (Damon, 1984). The potential of Peer Education (Tutoring and Assessment) has been investigated in the field of web-based collaboration and online tutoring (Mohammad, Guetl, & Kappe, 2009; Stepanyan, Mather, Jones, & Lusuardi, 2009; Westera & Wagemans, 2007). Results show the motivational benefits and improved social and knowledge skills. Currently ongoing research investigates the effect of Peer Education in a structured classroom-setup to learning and motivation based on the concepts of *Asynchronous Play* and *Casual Multiplayer* (Konert, Richter, Göbel, & Bruder, 2011).

3   Approach

To enhance the game play of one player in a singleplayer, story-based *Serious Game for Learning* by added content or influence from outside, we identified 3 dimensions to address for creating a taxonomy:

1. *Game Situations* (distinct contexts in the game a player can be confronted with)
2. *Mapping Patterns* (one to one, one to many, many to one, many to many)
3. *Social Media interaction patterns* (Julien, 2011)

Each of these dimensions needs to be elaborated as a discrete list of items. The cells of the resulting three-dimensional grid then can be filled with specific implementations of interactions in the context of SGLs connected to OSNs taking into account the concept of *Peer Education*.

Such a taxonomy is expected to help developers of *Serious Games* to enhance the learning by implementing functionality to support the interactions listed in the taxonomy. Examples of such beneficial functionality can be: players who can get assistance from outside the game without pausing (their game), non-players and related persons who can contribute to game play and influence it or other players who can contribute hints, solutions and complement guidelines.

Social Serious Game Definition.
In this paper a taxonomy and approach is presented how to enhance *Serious Games* by *Social Game* components. The enhances variant of Serious Games will be defined as Social Serious Games:

A *Social Serious Game* is a *Serious Game* with all components mandatory for a *Social Game*.
This includes the use of Social Media interaction patterns for *Peer Education* as listed in the *Social Game Interaction Taxonomy*.

4 Dimensions

4.1 Game Situations

The list of *Game Situations* has been developed in cooperation with CEOs of two game development studios in the area of Frankfurt, Germany. It focusses on the genre of adventure *Serious Games* which are singleplayer and story-based. The list is currently neither considered to be completed nor evaluated to be accurate, but is expected to be of value to relate the *Social Media* interaction patterns to it. *Game Situations* identified so far are listed in Table 1.

#	*Game Situation*	*Description*
1	Game Start	Introduction Scene, normally without interaction possibilities for the player except a skipping possibility
2	Game Scene	A general game scene without any specific situation as listed next
2.a	NPC Dialog Scene	A non-person character is in conversation with the player and waits for the player to answer (e.g. from a given list of dialog options)
2.b	New Quest Scene	The user reads and receives a new quest to solve. Quests can be of type Information Seek, Inventory Quest or Riddle
2.c	Branching Scene	The player can decide between several choices (not dialog) for the further development of the game story. Usually these branches in the scene graph of the game are irrevocable
2.d	Minigame Scene	A game in the game that is in itself enclosed like a memory, puzzle or equation to solve.
2.e	Conflict Scene	A fight or situation demanding a time-critical reaction from the player.
2.f	Quest Solving	The player solves a quest
3	Situation Loops	The player reaches no further progress and repeats actions several times or comes along same place without any contextual change (inventory, quests, environment)
4	Savegame	The current game status is saved for later re-loading
5	Game End	The player closes the game application

Table 1. Game Situations identified in story-based Serious Games for Learning

4.2 Mapping Patterns

It is the intention of the authors of this paper to extend the currently mostly one-way connections between (social) games and OSNs by focusing mainly the other way around: Information flow from social networks into games and participation possibilities from social network users. Considering both ways between games and OSNs, the mapping patterns listed in Table 2 can be identified. The patterns *n:n* and *n:1* are

listed for consistency reasons (shown *italic*) and will later on not be considered, as this paper focusses on singleplayer games.

Mapping Type	Description
1:1	One player in game interacts with one specific user in the OSN
1:n	One player in game interacts with many users in the OSN
n:n	*Many players of the game interact with (the same) many other players in the OSN*
n:1	*Many player of the game interact with (the same) one specific user in the OSN*

Table 2. Mapping Types identified for the connection of game players and users of OSNs

4.3 Social Media interaction patterns

The *Social Media* interaction patterns listed in Table 3 are structured and described in (Julien, 2011). As they are originally described for interactions between two users of the (same) *Social Media* application, the descriptions here focus on the interaction between game players and users of OSNs which are per definition Social Media applications (Boyd, 2009). As posting, sharing and updating are similar they are grouped and later on referred to as *Post* only. *Buy* and *Play* are shown *italic* as they will later on not be taken into consideration anymore, because they do not fulfill the criteria of a direct influence to or response by another user or many users as defined in ("interaction - definition of interaction by the Free Online Dictionary, Thesaurus and Encyclopedia.," n.d.). Finally eight interaction patterns are left for the taxonomy.

#	Social Media interaction pattern	Description
1	Post	A user can store new content
	Share	A user can share content
	Update	A user can quickly share a short piece of information
2	Vote	A user can favor or disfavor a content element
3	Comment	A user can respond to specific content element
4	Chat	A user can communicate directly with another user
5	Tag	A user can enrich content with metadata
6	Invite	A user can ask another user to perform an action
7	Connection	A user can establish a link to another user
8	Join	A user can associate himself with an interest group
	Buy	*A user can directly purchase a product or make a donation*
	Play	*A user can engage with a game*

Table 3. Social Media interaction patterns (Julien, 2011)

4.4   Taxonomy Model

The *Mapping Pattern* as the second dimension has only two characteristics which we will take into account. Thus the three dimensional taxonomy can be listed as two Tables; one for each *Mapping Pattern*. The Tables consist of the eleven *Game Situations* as rows and the eight *Social Media* interaction patterns as columns. Most of our identified interaction types to be listed in these Tables are valid for *1:1* and *1:n* simultaneously. Interactions incoming to the game player are in several cases only suiTable for the *1:1 Mapping Pattern* only. Still, Table 4 contains the data for both *Mapping Patterns* and the ones only valid for *1:1* are printed *italic*. There are no interaction types only valid for *1:n*. Explanations for the interaction type examples used in the cells are listed below as Table 5.

First Conclusions.

The Tables 4 and 5 are currently work in progress and not yet evaluated or proven and do not claim to be totally complete. Still it is valuable to interpret them and draw some intermediate conclusions and discuss them for the game development of *Social Serious Games*. As seen in Table 4 especially *Vote* tends to be a *Social Interaction* that suits well both *Mapping Patterns 1:1* and *1:n*. The most differences between *1:1* and *1:n* exists for *Post*, as content contributions are made individually and not collective. Thus the differences are mainly the incoming content (I:) for *Game Situations*. Additionally, cooperation modes are not applicable in a *1:n Matching Pattern* of a single-player SGL, but for the embedded minigames a (massive, cooperative) multiplayer mode is imaginable as well as a (massive) sidekick concept for *Conflict Scenes* in such games (e.g. a scene with a boss opponent).

For a technical implementation it seems to be reasonable (based on the number of interactions in the Table) to focus on the support of *Post* and *Vote* first, then on *Comment*. Concerning the examples in the Table 4 individuals (*1:1*) might be a most valuable source for creative content, hints or solutions for game situations as for *1:n* most content-related (*Post*) incoming (I:) entries are not valid. However, many (*1*:n) connected users, e.g. the friends connected to the player in an *Online Social Network* tend to be a valuable source for *Vote* results and recommendations. As seen in Table 4 this is the only column where all items are available for both *Mapping Patterns*. Because more people can possible contribute in *1:n*, the *Vote* might be even of more value here compared to *1:1*. A combination of both (*Post*, *Vote*) could be a content contribution of individuals, voted by many others for recommendation.

In both Mapping Patterns it seems to be suitable to *Post* the status (achievements), *Vote* with likes and send invitations from the ongoing game to the connected other users in order to raise awareness and call for participation. It can be assumed that such interactions become more valuable if the recipients are invited to take action, e.g. combining it with a call for a *Vote* or content *Post* to involve them into ongoing game play.

For minigames and *Conflict Scenes* (all scenes with time-critical reactions demanded) *Chat* and *Connection* can be considered to be implemented as they allow a collaborative or competitive scenario in the otherwise singleplayer game play.

#	Game Sit.	Post	Vote	Comment	Chat	Tag	Invite	Connection	Join
1.	Game Start	*I: inventory equipment* O: status	I: inventory equipment, scene selection				O: rec., streaming	*I/O: cooperation*	*I: cooperation*, streaming
2.	Game Scene	*I: solution, question, pers. content* O: status, screen, solution, question	I: scene selection, assessment O: content rating	I: solution O: solution	I/O: consultation	*I: content location* O: content location	O: rec.	*I/O: cooperation*	*I: cooperation*
2.a	NPC Dialog Scene	I: *dialog option*, names O: dialog decision	I: dialog option, traits	*I: dialog answer*	*I: dialog takeover*			*I: dialog takeover*	O: join decision (indirect)
2.b	New Quest Scene	I: *tasks, rewards*, item donation, item repairing, params O: quest decision, question	I: available quests, tasks, rewards, quest parameters O: quest likes	I: banter O: notes, restrictions		I/O: categorization	O: rec.	*I/O: cooperation*	*I: cooperation*
2.c	Branching Scene	*I: false decision items* O: branch decision	I: branch options O: branch likes	I: banter					
2.d	Minigame Scene	I: game content	I: minigame options O: minigame likes				I: content rec. O: rec.	I/O: cooperation, competition	I: cooperation, competition
2.e	Conflict Sc.		I: traits, difficulty, tactics, inventory		I: barter, acclamation		O: sidekick	I: sidekick	I: sidekick
2.f	Quest Solving	*I: rewards* O: rewards	I: assessment O: quest likes	I: *shouts of victory*, questions, remarks O: remarks		I/O: categorization	O: rec.		
3.	Situation Loops	*I: assistance* *O: assistance request*			I/O: consultation	*I: content location*	*O: assistance request*	*I/O: cooperation*	
4.	Savegame	O: savegame, status	I: likes, usages	I: likes O: remarks		I/O: categorization	O: rec.	I/O: affiliation	I: usage
5.	Game End	*I: questions* O: status, solutions, question	I: assessment O: likes	I: barter, acclamation (at stream)					I: rec.

Table 4. Social Game Influence Taxonomy (Incoming interactions to the game marked as *I:*, outgoing as *O:*, items only for *1:1* are *italic*)

Description of Influences.

acclamation (at stream)	sympathy or antipathy concerning the consumed (live) screencast video stream of the game played
affiliation	dynamic membership in an ad-hoc group of interest of all users connected or liking the same content, e.g. savegame
available quests	influencing the availability of quests a player can choose
branch options	influence to the available game branches a player can choose
branch likes	players and/or users can express their (dis)favor
categorization	players and/or users can edit or add metadata
content location	placing items in the game context, map or area
dialog takeover	the dialog is not any more answered by a NPC, but by humans
false decision items	contribution of (creative) but wrong answers to a question or decision to make
item donation/repair	other players/users owning items can help by donation or repair
join decision (indirect)	NPC dialogs can ask players for favorites or memberships resulting in joins e.g. of affiliated interest groups in OSNs.
params	abbreviation for parameters, e.g. difficulty, time restrictions
rec	abbreviation for recommendations, e.g. recommending a quest
restrictions	players/users can express (by text) self-imposed restrictions making the game e.g. more fun or harder
sidekick	Assistance player restricted to competition support, not capable of interacting with story pacing (e.g. co-fighters)
usages	who/how many other used this item

Table 5. Description of influence type examples used in Table 4

Other influences are not explained explicitly as they are assumed to be self-explaining.

Research questions.

From the above discussed conceptual ideas the following research questions have been identified to be focused on in future research.

- RQ1: Do game developers value the taxonomy as reasonable covering the main influence kinds for their *Serious Games for Learning*?
- RQ2: Do players value such features in games for *Peer Education* and knowledge transfer?
- RQ3: Are players more engaged and reach further in the game if games are enhanced by the *Social Game Influence Taxonomy* system?
- RQ4: Can the awareness of *Serious Games* be increased for non-players by the participatory effects and interactivity caused by the use of the *Social Game Interaction Taxonomy* compared to (passive) wall posts?

4.5 Middleware Design

Technically the taxonomy is used in a framework that works as a component-based service middleware between existing *Serious Games* that use the offered services and different *Online Social Networks*. As identified in the conclusions of section 4.4 (Model) *Post* and *Vote* are the main *Social Influence Patterns* to be supported first. Consequently the architectural diagram drafts the *Social Game Content Integration* component for *Posts* and the *Social Game Influence System* for *Votes* (see figure 1).
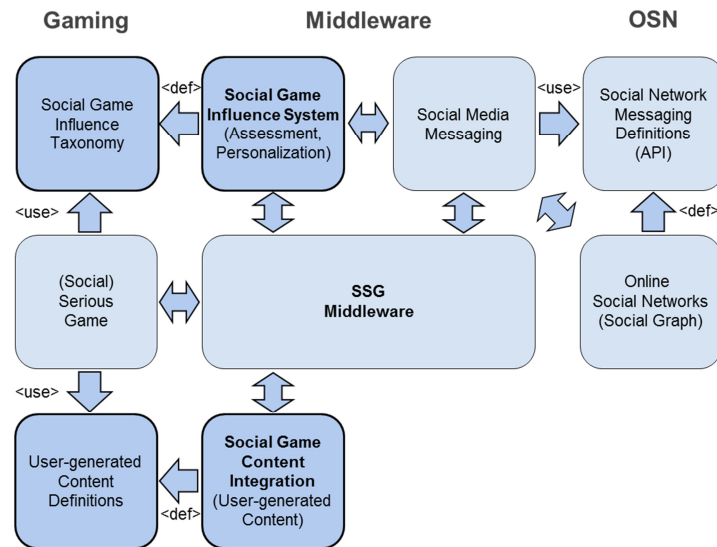
Fig. 1. Middleware design for *Social Serious Game* (SSG) middleware
legend: <def> for definition, <use> for usage (access)

Content Integration for Posts.

Game developers use the defined content definitions (to be described in a future paper focusing content integration) to fetch or store user-generated content from the middleware repository. This can be hints, screenshots, screencast streams and other formats existing in the game or social network on one side or provided hints, solutions, questions from users of OSNs or from other players on the other side.

Influence System for Votes.

Game developers use the defined interaction patterns of the *Social Game Interaction Taxonomy* and invoke concrete influences by selecting a pattern and setting parameters like number of answers, timeout and so on. The middleware component *Social Game Influence System* then instantiates the influence, sends messages to the OSNs, collects feedback and provides the result to the game. Aspects of the service implementation cover content filtering, abuse protection, data privacy policies and the dynamic rendering of the influence system's web interface for users who respond to messages and follow the invitations (links) embedded in the wall posts (e.g. on face-

book). Technically supported are right now: single choice, multiple choice, *n out of m* choices, ordering, text gap, image upload and combination of these, e.g. singe-choice with the option to add new options with a text field.

Technical components.

The middleware has been developed as a *Java Servlet* application supporting multiple games and multiple-user access. It is designed to connect to multiple OSNs that support the *OAuth* authentication system and provide access to the profiles and graphs via an *Application Programming Interface* (API). The provided web-access for users to vote and contribute content is generated by a *Google Web Toolkit* (GWT) servlet of the middleware. All access to content items is as well possible for game instances via the API provided from the SSG middleware. A list of the main API methods is shown in Table 6. Beside a few methods for authentication that set and check a HTTP access-cookie (not listed) all methods are designed stateless to reduce the interdependencies and complexity of API method usage.

API method	Functionality
allocateContent	Prepares the receiving of a content item. Usual parameters are metadata about the game, game scene, player, description or type of content. The types are a predefined list that can be extended by game developers with proprietary keys. The method returns a unique *contentId*.
uploadContent	Uploads the content for the given *contentId* to the middleware. This can be textual or binary and does not need to be readable by the middleware
getContentInfo	Based on filter information gives as parameters a result list of all stored and visible content is returned from the middleware. The list contains all metadata, but no content itself.
downloadContent	For specific *contentIds* the content can be downloaded and be parsed according to the content type.
prepareInfluence	Prepares one influence pattern as defined in the taxonomy. These are available as enum values. Usually the minimum parameters are a question (to state) and multiple- or single-choice answer options depending on the selected pattern. Returns a unique *influenceId*.
startInfluence	The defined influence (using the *influenceId*) can be made visible. Parameters are only the timeout. This triggers publication to social networks. If no one participated a default result is returned. If uncommented by users, the posts are deleted after timeout from OSN walls.
fetchResult	Using the *influenceId* the preliminary or final result can be fetched.

Table 6. Main API methods of the SSG middleware

5 Outlook

The described taxonomy and the middleware will be further shaped during ongoing implementation and tests. We plan to evaluate the usability and find answers for research questions RQ2-RQ4 with a user study at the end of 2012. Therefore a 3D *Serious Game for Learning* will be connected to the middleware using the *Social Game Influence System* and the *Social Game Content Integration*. A qualitative study has been conducted in April and May 2012 as interviews with six CEOs or senior software developers of German game studios that develop *Serious Games*. The transcription of interview data and results of the analysis will help to answer RQ1.

The ongoing research aims to find technological solutions, approaches and patterns to prove the improvements for knowledge exchange and learning in *Social Serious Games*.

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