Creating Opportunities to Learn Social Skills at School using Digital Games

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Abstract: Acquiring skills for social and emotional well-being is important for inclusive societies and academic achievement. Studies have demonstrated the beneficial link between prosocial behaviours and improved results in curriculum topics. This paper describes a Prosocial Learning (PSL) process for creation and delivery of digital games for children (7-10 yrs) within educational systems that support learning of prosocial skills. The approach combines prosocial pedagogies with advanced ICT technologies and cloud delivery models to create attractive and exciting learning opportunities for children; produce novel digital game-based pedagogies and simplify deployment.

Prosociality is a concept that refers to an individual's propensity towards positive social behaviours. Individuals with prosocial skills are, for example, able to join in conversations, talk nicely, identifying feelings and emotions in themselves and others, identify someone needs help and ask for help. PSL classifies these skills in terms of Friendship, Feelings and Cooperation. By using interactive digital games supported by additional instructive and reflective activities, PSL allows children to learn social skills that can be generalised to real life situations in the classroom, playground and at home.

PSL is implemented through a technology platform offering systematic pedagogical support for prosocial games developed by an ecosystem of teachers and games companies. Capabilities include multi-modal sensors to observe emotional affect, game interaction and decision-making. Information is acquired through standard protocols (e.g. xAPI) and evaluated by learning analytics algorithms to provide real-time feedback on player behaviours that are be used for in-game feedback and adaptation, and by teachers to shape follow-up activities. PSL is validated through short and longitudinal studies at European schools to gather evidence for effectiveness. This paper provides early evidence from short studies that will steer larger pan-European trials to test hypotheses, promote to policy makers and to increase adoption of game-based learning in schools.

1. Introduction

Providing opportunities for all children to acquire skills for social and emotional well-being is important for inclusive societies, academic achievement and employability. Games, particularly games that involve a group of players offer a dynamic approach for developing and refining fundamental life skills for children. However, current digital games targeting the education sector are low quality and fail to capture the imagination of players, significantly reducing their effectiveness. It's clear that traditional game designers know how to produce engaging stories and game content but they are lacking scientifically-proven game mechanics and associated pedagogies that can be used to create serious games in way that delivers beneficial outcomes for players. In this paper we describe a Prosocial Learning (PSL) process for creation and delivery of digital games for children (7-10 yrs) within educational systems that support learning of prosocial skills. Prosociality can be defined in multiple ways (Penner et al, 2005), with the simplest one explaining it as the behaviour of helping others. Prosocial acts include helping, sharing, donating and cooperating with others, as well as conforming to socially acceptable behaviour. Prosocial actions may be motivated by empathy and concern for the welfare and rights of others, as well as for egoistic or practical concerns, such as one's social status or reputation, hope for direct or indirect reciprocity, or adherence to one's personal values of fairness. Children lacking prosocial skills are among the most highly referred concerns of parents and teachers. Considerable evidence suggests prosociality to be central to the well-being of social groups across a range of scales (DeRosier, Kupersmidt, & Patterson, 1994; Hymel et. al., 1990). Studies have demonstrated the beneficial link between prosocial behaviours and improved results in curriculum topics and academic achievements (Caprara et al, 2000), (Clarke

et al, 2015) (Flook et al, 2005). We advocate that prosocial skill acquisition through digital games have the potential to help individuals develop positive interpersonal relationships and can therefore be considered as a key contributor to maintaining social inclusion. Our approach combines prosocial pedagogies with advanced ICT technologies and cloud delivery models to create attractive and exciting learning opportunities for children, to produce novel digital game-based pedagogies and to simplify deployment within school environments. In Section 2 we discuss the PSL process from the pedagogical perspective and in Section 3 we outline the Social Learning Platform; Section 4 presents the results of a validation study involving students within European Schools and Section 5 draws the conclusion.

1.1 Related work

Games are an interesting field to be explored by different specialists, and for many reasons. There are games increasing educational skills (Murphy et al, 2001), games designed for specific purposes like conflict resolution among children and many studies have investigated the effect of the amount of game-play on different specific aspects of children life (Green & Bavelier, 2003), (Pillay, 2002), (Boot et al, 2008). Most studies exploring the effects of gameplay on player's general behaviour have focused on the impact of game violence (Anderson & Bushman, 2001, 2002). Findings suggest that certain relations between game content and attitudes related to aggression exist (Anderson & Bushman, 2002). Feelings and thoughts are more fragile aspects of behaviour in the short-term, while aggressive attitudes, perception mechanisms and desensitization can be equally affected in the long-term as functions of violent and continuous game-play habits. The effect of exposing children to violent behaviours, whether real or virtual, has been extensively studied, as well (Osofsky, 1999). While exposure to violent games breeds anti-social and aggressive behaviours, conversely other kinds of games have positive impact on the formation of a child's personality. Indeed, non-violent games, in which helping and caring for the others could increase prosocial skills and be more than just a hypothesis. Recently, studies investigating the effects of prosocial game-play have appeared (Gentile et al, 2009). These studies, although exhibiting strong results, are limited, mainly due to the fact that there exist only a few games with main characters modelling helpful and completely non-violent behaviours (Anderson & Bushman, 2001), while their scope is prosocial only "by chance", in the sense that their development is usually targeting entertainment. Social game designs must extend notions, ideas and principles of game theory, pedagogy and psychology. The scripts move beyond well-established games to incorporate multiple learning objectives targeting a much richer set of social skills. In (Axelrod & Hamilton, 1981), different strategies are analysed, namely the nice, retaliating, forgiving and non-envious. Such strategies can trigger emotional affect in a players which are typically highly individualized and context dependent issues, and important for learning social skills (Spence 2003). Social game scripts must involve richer characteristics and ideas, tailored for developing prosocial principles in one's character, instead of simply detecting prosocial signs. In this sense, social game content allows participants to appreciate collaborating with each other, to join in conversations, talk nicely, identifying feelings and emotions in themselves and others, identify someone needs help and ask for help, whilst platforms must automatically providing ways to observe emotional affect throughout gameplay situations. Cloud-based solutions are emerging to support serious game learning analytics (van der Vegt et al, 2016), but they lack of integration with sensor observation and specialisation towards learning social skills.

2. Pedagogical Approach to Learning Social Skills

Teaching social skills through digital games in school environments requires a robust scientific approach to maximise the potential positive benefits to students, to increase acceptance of novel game-based learning by teachers and to provide game designers a methodology for creating games that are effective. Evidence-based research indicates that successful learning of social skills requires well-designed classroom-based programs that target the range of prosocial competencies, provide opportunity to practice, and offer multi-year programming. Prosociality is an abstract concept that is conceptualised, investigated and applied within the disciplines of psychology and pedagogy. Developmental psychology has shown that prosociality can be understood using domains (Eisenberg & Mussen, 1989) such as empathy, trust, fairness, generosity and cooperation. Although the domains are useful in explaining prosocial concepts that children need in order to be successful learners and be socially included, the concepts are complex social constructs that are difficult to define, measure and incorporate into measurable learning objectives. From a pedagogical perspective the Collaborative for Academic, Social, and Emotional Learning (CASEL) (Zins et al 2004, Bridgeland & Bruce & Hariharan 2013) and Skillstreaming (McGinnis & Goldstein, 1997) offer practitioners systematic approaches to teaching social skills. The CASEL framework offers five social and emotional learning competencies: self-

awareness, self-management, social awareness, relationship skills and responsible decision making whereas Skillstreaming identifies 60 skills deemed necessary for prosociality that are lacking in students. Skillstreaming focuses on sequence of learning strategies; instruction/description, modelling, role-playing, performance feedback and generalisation (trying the skill in different context). Both skill-deficit, where the child lacks the know-how about a behavioural skill, and performance-deficit, where the child is aware of the correct behaviour but fails to reproduce it in the correct circumstance, are addressed through this technique. For example the child may have the know-how on how to carry out a skill but because of lack of positive reinforcement, or lack of confidence the child does not perform the skill in the appropriate setting. PSL adopts a skills based-approach to learning social skills. We have identified an initial set of 40 skills within three classes: skills for friendship, skills for feelings, and skills for collaboration. The skills were selected considering their applicability to and benefit from digital game-based learning, for example, the skill can be measured through sensor observation and monitoring tools. The skills are also of different difficulties and can be incrementally learnt to progress students through levels of prosociality. For example, identifying feelings is necessary to be able to showing concern for other's feelings or dealing with angry feelings. Each game can be used to learn one or more skills depending on the nature of the game situations, decisions and mechanics.

Classification	**Prosocial Skills**
Skills for friendship	Communicating with others, Using Nice Talk, Introducing Self to Others, Introducing Others, Joining in a Conversation, Joining a Play Group, Sharing About Oneself, Sharing Your Things With Others, Learning About Others, Being an Active Listener, Giving Compliments, Receiving Compliments, Respecting Others, Respect for Others' Personal Space, Not Interrupting Others
Skills for feelings	Self-Control, Identifying Feelings and Emotions, Expressing Feelings and Emotions, Understanding Social Cues, Showing Concern for Others' Feelings, Dealing With Stress, Dealing With Anxiety, Dealing with your angry feelings, Dealing With Another Person's Angry Feelings, Dealing With Rejection, Dealing With Being Left Out, Dealing With Boredom
Skills for collaboration	Setting Goals and Obtaining them, Solving everyday problems, Solving a Problem as a Group, Following directions, Paying Attention, Staying on Task, Working Independently, Cooperation, Taking Turns, Being a good sport, Being Patient, Being assertive, Saying No, Accepting No, Asking for Help, Helping Others

Table 1: Initial set of identified skills

Programs should provide repeated opportunities to practice new skills and behaviour within the structure and how to model this in real-life situations (Bridgeland & Bruce & Hariharan, 2013). For effective social and emotional learning programmes, implementers are urged to approaches such as the "SAFE" procedures [Durlak and colleagues 2010; 2011]. The parallels between a game world and interactions and the real world and interaction, if made explicit, can indeed provide the opportunity to practice real-world skills over and over again with enough variety, a range of positive reinforcements and just-in-time corrective feedback to keep the players engaged [Gee 2003]. We therefore define a learning process for social games that are used to help teachers and games designers maximise the benefit of social games:

- **Instruct**: Verbal and written description of skill and steps to perform the behaviour, including highlighting benefits and short term and long term outcomes of behaviour. Both teachers and students take part in describing and discussing the skill and the steps to reproduce it.
- **Model**: The behaviour or skill is demonstrated step-by-step (i.e. modelled). More than one model set should be used, ideally both physically and digitally i.e. two adults, two characters in the game, one child and one adult, one child and a virtual character, and finally two children. Children also encouraged to internally rehearse the behaviour or skill steps (in their mind's eye).
- **Role-play**: The children imitate or role-play the modelled behaviour and skill steps. The behaviour must be over rehearsed, through the children practicing the skill over and over again. The behaviour or skill must be demonstrated and practised in different contexts such as peer group, home, school, community.
- **Feedback**: During play provide in-game performance rewards linked to real world activities or material or social reinforcement e.g. stars or scores to show success or progress. Provide in-game corrective feedback, from system and other players. Provide opportunities (like pauses) for teachers to provide verbal and non-verbal feedback.
- **Generalize**: Generalization is the most important step. It helps players identify where and when to use the skill and how to apply it in variety of circumstances. Methods include: reflection, perspective-

taking, homework based on carrying out the skills between peer groups, at home, at school and within the community.

3. A Social Learning Platform

The platform starts by considering how to supports interactions between different users of the platform (teachers and games companies). Games companies produce value by offering a range of social games to teachers for evaluation and incorporation into lessons. Games are developed using the platforms Prosocial Service API that aims accelerates game development by supporting a PSL process through generic capabilities for student emotion observation and fusion, game interaction monitoring, social learning analytics, feedback and adaptation and access to the educational game marketplace. Through these capabilities, games using the platform support a learning analytics pipeline that transforms student monitoring and observations into actionable insights for teachers as part of reflection and feedback activities, or for dynamic intelligent adaptation of the game itself (beyond the scope of this paper). Three analytics channels are combined to provide knowledge of a player's prosocial behaviour (See Figure 1).

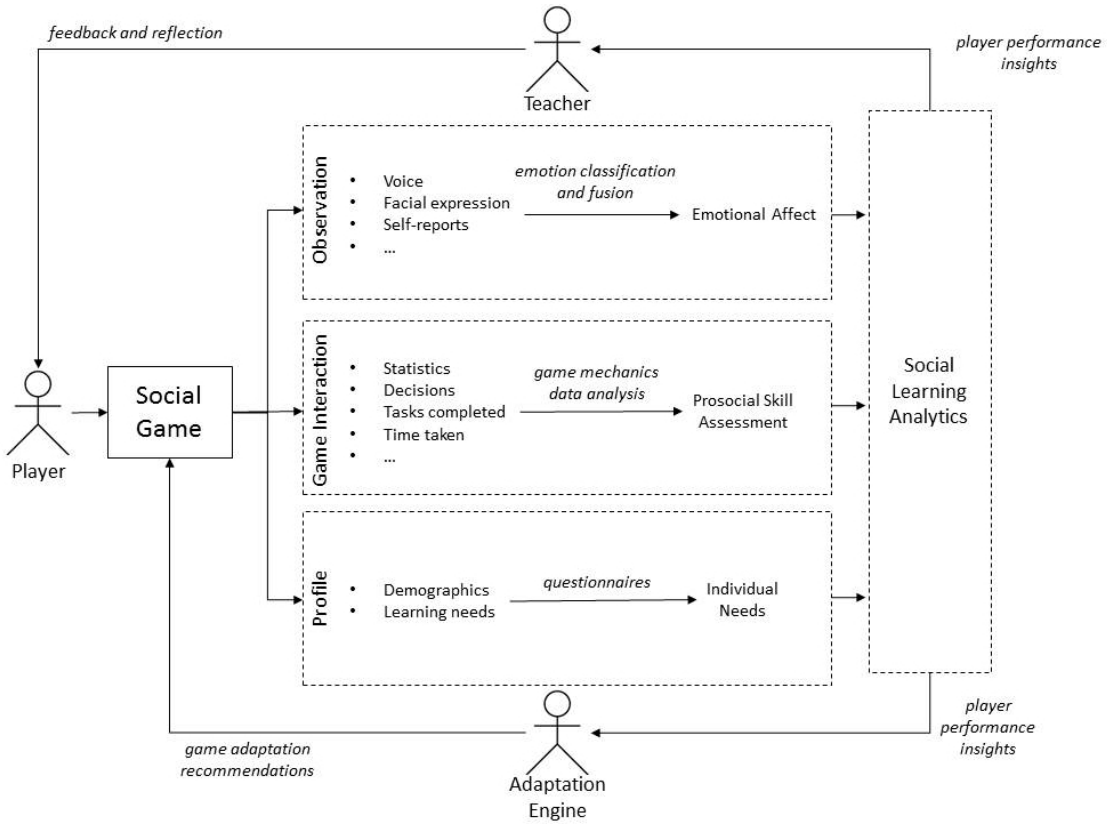

Figure 1: Prosocial learning analytics pipeline

At runtime skill is acquired through game interaction monitoring whilst temporal emotional state is observed through multi-modal sensors analysing voice and facial expression. The data is stored across multiple games as part of a user profile and combined with off-line questionnaires capturing additional information such as demographics and cultural context. The platform aims to offer capabilities supporting the PSL process through an API offered to games developers and decision support tools for teachers. The high level platform architecture is shown in Figure 2 organising according to the PSL process.

The adoption of digital games by the formal education sector requires significant innovation in practices of formal schooling, and in the procurement and certification systems for education products. Issues such as the lack of community of practice and time to prepare lessons based on games, the perception that the game takes over from the teacher and incompatibility with teaching practices and general fit to the curriculum are some of the challenges faced by games companies targeting the sector. Our approach to resolving these problems is to provide a platform supporting the multidisciplinary, co-creation of social games in a way that bridges the gap between communities of teachers and game developers, whilst accumulating evidence for the

benefits of social games within schools. Teachers access games and work with game designers to create and share usage scenarios, lesson designs and success stories within educator networks, promoting adoption and best practice for the wide variety of educational settings expected in schools. The platform operator's business model is based on revenues derived from interactions between users (schools and games companies). The platform seeding strategy focuses on establishing a set of exemplar games created by teachers and games companies that used to build evidence and are promoted through regional ambassadors. The goal is then to rapidly grow the network on a global scale and remove barriers to interaction. How the interaction translates to revenue is dependent on the business model (e.g. pay-per-use, subscription, advertising, etc.)

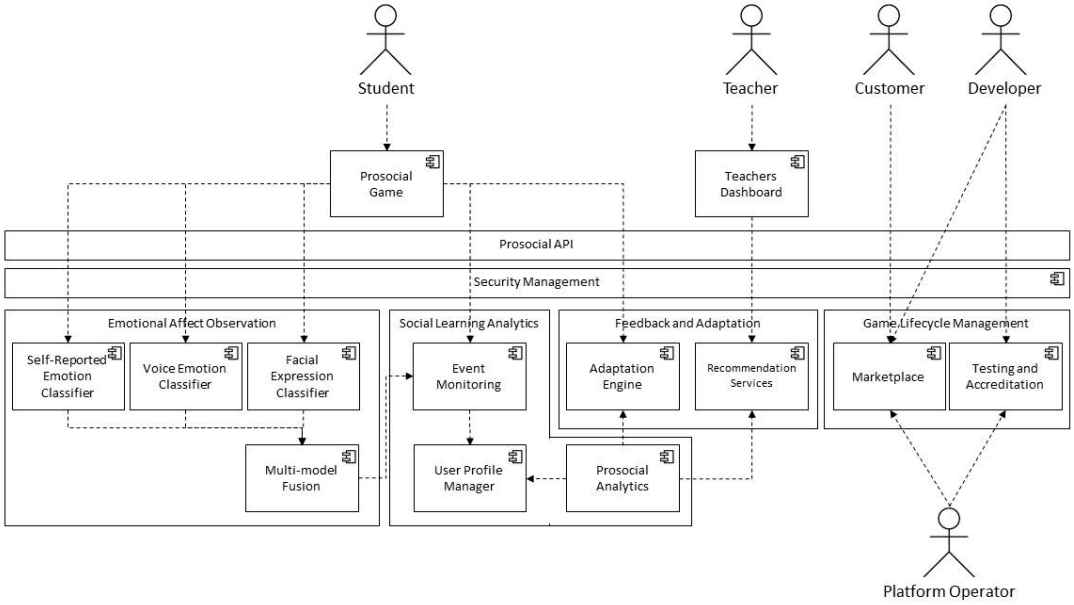

Figure 2: Prosocial learning platform architecture

3.1 Emotional affect observation

The emotional affect experienced by individuals from social interaction is closely linked to prosociality. People who experience positive emotional responses to situations tend to exhibit positive helping behaviours (Drouvelis & Grosskopf, 2016). As such the platform provides capabilities to automatically acquire and classify player emotion in relation to game play events. A series of multi-modal observation channels are established from input sensors connected to player devices including microphones, cameras and mouse/touchpad. Using sensing and classification techniques emotion from voice, facial expression and body language is be acquired and then fusion processes applied to provide temporal emotional state. Observations are modelled in accordance with the OMG's Structured Metrics Meta-model (SMM) model (See Table 2). Many emotional models exist in literature (Ekman, 1992), (Russell, 1980), (Plutchik, 2001), (Mehrabian, 1996). We use a valance-arousal space (Russel 1980) in order to measure emotion in all input modalities. This common representation allows us to compare and contrast the measures of emotion coming from different sensors. This is important if we want to perform data fusion. Individual sensor data is classified in the valence-arousal space via pre-processing and classifiers. The classifiers have been pre-trained on representative data. After emotion classification, decision level fusion is employed. This serves to bring together the differing measures of emotion and find a best estimate for a given time instant. This fusion process happens in the valance-arousal space. As the two terms are independent it is modelled via a pair of decision fusion systems.

OBSERVATION	FEATURES OF INTEREST	MEASUREMENT	MEASUREMENT UNIT
Voice	Various sound features (energy in frequency band, pitch, duration)	Audio stream capture, feature extraction, and classification	Valance-Arousal
Facial Expression	Distance and angle measures associated with eyes, eyebrows, and mouth	Video stream capture, feature extraction, and classification	Valance-Arousal
Self-Reported Emotions	Feedback provided by the user on perception of valence and arousal	Selection of valance and arousal via in-game emoticons	Valance-Arousal

Table 2: Examples of Emotion Observation Model

3.2 Social Learning Analytics

Acquiring knowledge of player's prosocial behaviours during game play necessary to understand competence in relation to desired prosocial skill, points of interest within game play situations requiring feedback and discussion and ways the game can be adapted to best suit individual needs. As such, the platform maintains a user profile that stores game interaction monitoring, emotional affect and other offline profile data. User profile data is analysed by social learning analytics to automatically assessment prosocial skills for teachers and game adaptation. We expect most games used within schools to target browsers and mobile devices such as tablets. The protocols for event reporting must be browser independent and standards (i.e. HTML5 and Javascript) based to ensure portability and interoperability. The WebSocket protocol is used for game interaction monitoring to provide near to real time monitoring channels for game adaptation or when recommendations to teachers for intervention (e.g. stopping the game). The protocol incorporates Experience API (xAPI) specification (xAPI 2016) that is designed to track informal learning, social learning, and real world experiences. xAPI is highly applicable for performance assessment of learning activities within serious games and provides a flexible and standard-based solution for games developers. The protocol is abstract enough to enable reusability within many games and implement extensibility to support addition of new skills. We extend the RAGE learning analytics platform (van der Vegt et al, 2016) towards concepts supporting the pedagogical framework for learning social skills. The Social Learning Analytics component interprets user profile data to feedback and recommendations to the teacher and game adaptation. The analytics are set of functions defined and applied to the user profile according to a skill assessment model. For example, in a cooperative game where multiple players are learning skills for collaboration such as how to help others, we can define a function that measures the level of cooperation through the decisions made within the game and then correlate game interaction events with temporal emotional affect.

3.3 Recommendation and Adaptation

Feedback and reflection on learning experiences, and adaptation to individual learning needs is an essential element of the pedagogical approach. A key goal is to automated monitoring, analysis and visualisation of player behaviour, to offer teachers additional insight into student performance that is difficult to observe through traditional teaching methods. As such, the platform provides a Teachers dashboard that provides visualisation of player performance data including general game statistics along with temporal views of prosocial skills and emotional affect during games that can be reviewed and replayed with students. The dashboard is based on extensions to solutions for observing and analysing collective social experience (Phillips et al, 2015). A key capability is allowing teachers to define conditional triggers associated with observations and game interaction data for both individuals and groups of players to alert at points of interest, such as, one player is angry and at the same time another player makes an anti-social move, or one player is bored and disengaged from gameplay. We recognise that triggers are often context dependent and it requires practitioners to determine the appropriate conditions when intervention is required and how such intervention should be implemented. For example, if a player becomes angry during game play it is for the teacher to decide if and when the game should be stopped and how feedback should be given, either as a group or individually. At the same time, conditions can be used to trigger a signal to the adaptation engine recommending a change in the game. For example, if the collective level of cooperativeness in a cooperative game has been high yet the group did not win due to chance factors and emotion observation measures widespread frustration, then an alternative reward may be desirable. The analytics will provide an abstract trigger event (e.g. "recommend to deliver addition reward") to the adaptation engine and ultimately to the game to implement within the specific game script.

4. Validation Study

A real-world evaluation of the PSL process and technical platform was carried out with the objective of capturing data that will enhance our understanding of the relationship between game interactions, emotional responses and prosocial behaviours in children during game play. To this end '*The Chase*' game was developed to explore the pedagogical framework: *skills for collaboration*. In this game, the skills focussed specifically on *cooperation*; *taking turns*; *asking for help* and *helping others*. From a mechanics perspective the game is based on public goods theory (Cornes & Sandler, 1996) that requires players to trade off their private goods to preserve the public benefit of the game's team.

In the game, up to four players take turns to move their teams' pieces along a series of steps and away from the 'Giggle monster' who does the chasing. On each turn a maximum of two moves are randomly assigned - meaning that either both player and monster receive one move each, or one of them receives two moves whilst the other gets none. Each player carries a bunch of balloons (25) which, at the end of the game, must sum to a minimum number (60) if the team is to escape in the hot air balloon at the end of the path. If during play the monster lands on one or more players, 5 balloons are forfeit for each. To avoid this, players may cooperate with each other by moving other players' pieces immediately in danger of being caught by the monster – this costs 1 balloon per move for the player helping others. Players therefore need to understand when it is advantageous to sacrifice some of their private balloons to maintain the team's ability to escape and also how to interact socially and cooperatively in order to do so. Two Italian schools were selected to participate in the study, from each of which one class of children were chosen to take part. Each school took part over the course of one day in which the class was divided up into 6 game groups of 4 players; games were played serially and lasted around 10 minutes each. The study cohort consisted of 11 girls and 13 boys in the first school and 7 girls and 18 boys in the second. Groups were arranged so to balance boys with girls as equally as possible; there were no single sex teams. Game play took place in dedicated game rooms in which children were provided low cost Android tablets that were wirelessly connected to the game server.

Figure 3: Students playing The Chase game

Before the study's game play sessions began, the class as a whole was introduced to the game concepts by teacher. Each of the 6 game groups played a single game to become accustomed to the user interface and game mechanics. After all game groups had played one game, the class took part in a reflection and feedback exercise in which the trade-offs in the game were explored and the children were given the opportunity to provide their views on the game and how it could be improved. Following this, each group played the game again; the study completed with a class oriented debriefing session and final feedback. *The Chase's* is integration with the PSL platform allowed us to automatically capture experimental observations in three modalities. First of these, game play interactions, are captured using the PSL Event Monitoring component and represent time-stamped records of moves made by all game protagonists and also automatic classifications of 'cooperative' or 'selfish' actions calculated by the game logic at run-time. Second, each player's voice is recorded (using the tablet's microphone) during game play – the digital stream of which is captured and stored by the Audio Acquisition component. Third is emotion scale data subjectively reported by game players through an additional UI provided by the Emotion Self Report (ESR) PSL component. The ESR UI presents players with two emoticons based, 5 element scales representing levels of arousal and valence respectively; ad-hoc subjective reports using these scales are also captured using the PSL Event monitoring component.

Our qualitative analysis of the children's social interactions (as observed by teaching assistants during game play) reveals a number of indicators that support the view that the prototype game engaged the children in prosocial learning. Our observations include evidence of i) positive changes in social dynamics during game play; ii) knowledge transfer used as a vehicle for helping or being helped; iii) significant cooperative dialogue. In many cases the social dynamics during game play initially produced one or two leaders in the group whom communicated strategy to others players. Leadership typically took the form of either interaction cues (i.e., simple instructions on what to press on the game UI) or explicit directions on which pieces to move in a given context. However often as the games progressed these leadership roles fell back to be replaced with more democratic, round-table discussions on the game state and requests for views on possible next moves. In these discussions there were clear cases of knowledge transfer with respect to understanding game play, developing strategy and advising others who asked for help. Some children physically moved over to others to point to game play elements and explain ideas. On several occasions players counted balloons and performed simple arithmetic in order to evaluate the game and then explain strategy. Orthogonal to these behaviours were social exchanges and emotion responses that seemed to be used in support of cooperative behaviour. In particular we noted many 'high fives' between players and remarks reflecting an understanding of cooperative acts and others' emotional states (such as *"I will use my move to save you"*, *"I am expecting that you give me a move because I gave you one"* and *"Sorry, I have to save myself"*).

5. Conclusion

In this paper, we have described a process and supporting platform for learning prosocial skills at school using digital games. Our approach demonstrates that by combining systematic pedagogies with advanced gaming technologies and cloud-based platform delivery models that teaching social skills to children using games is now possible in educational settings. Capabilities of the platform are offered to support games companies in developing content that is appropriate and beneficial to student learning whilst accelerating development and routes to market. Overcoming these fundamental barriers is an important step towards providing opportunities for a co-creative process whereby teachers and games companies explore and accumulate evidence for the benefits of learning through social games. Through our initial validation study, we have identified some early evidence to validate our games based approach to developing positive social skills and competencies in children. At the same time the technical capabilities of some of the PSL components and a prototype game have been tested in a real-world, educational environment. A more detailed analysis of the data is currently underway where the relationship between fine-grained emotion classifications and reports will be compared with game events and outcomes. The experiences gathered from running the study and feedback taken from both the students and teachers has also provided valuable insights that will feed forward into the continuing development of the platform and its games as well as long term evaluations already planned for a later stage. Future work will involve further short studies supporting a range of prosocial skills for friendship, feelings and cooperation before organising large-scale pan-European longitudinal trials.

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