Design Document

Introduction / Short description

The objective of the Siren games are to facilitate children in learning about conflict resolution and in resolving conflicts in a constructive manner. This includes understanding conflicts, analysing conflict situations, and applying different conflict resolution strategies.

The various games making up the Siren suite will each focus on specific learning objectives, and will make use of different underlying technologies. Some will be single player, while others will be multiplayer. All of these games will be linked from a central game universe, which will track individual and group profiles for students, along with degree of mastery of conflict resolution skills. For the rest of this document, this central game universe will be referred to as the *meta game*. The meta game, and its linked games, will primarily be played in a school setting, and under the supervision and guidance of teachers. Future modules (which will not be developed under the scope of the Siren project) may be playable at home as well. For the rest of this document, these different games will be referred to as *mini games*.

Target Audience

- students in the UK, Greece, and Portugal between the ages of 9 - 12
- teachers in the UK, Greece, and Portugal

Learning Objectives

The Siren games are, as a whole, premised around a number of core learning objectives, which take the form of *abilities*. These, in turn, will be promoted via certain *strategies*. These are described below.

Abilities

- **Perceptual**: the students should learn how to see an issue from different perspectives.
- **Emotional**: the students should learn how to recognise the distortion effect that strong emotions have on an issue.
- **Communication:** the students should develop skills in expressing one or more parties' perspectives or feelings on an issue, particularly when these perspectives are different from one another.
- **Creative-thinking:** the students should develop the ability to come up with a variety of conflict resolution options.

- **Critical-thinking:** the students should learn objective criteria for choosing between options and have experience with developing them.

Strategies

- **Focus on interests**: children are instructed how to focus on interests, not positions. This principle is based on the premise that “behind opposing positions lie a larger number of shared and compatible interests than conflicting ones.”
- **Mutual gain:** children are directed to invent options for mutual gain. The challenge is to come up with inventive solutions in which both parties can feel that they’ve gained something.
- **Apply objective criteria:** When people advance different standards for choosing between one of the possible conflict resolution strategies, it is critical to find some objective criterion for deciding between them, for example, whether a particular standard has been used by them before or is widely applied by other people.

Each mini game will focus on a specific subset of these abilities and strategies. This will be explained further below.

Meta game concept

The Siren meta game takes place in an imaginary village set in pre-industrialisation times. The village has an existing history, and particular alliances that exist between the inhabitants, who come from a range of backgrounds and have various professions (including, for example, farmers, blacksmiths, restaurant owners, tailors, and actors). Some of the inhabitants of the village are non player characters (NPCs), but many of them will be player characters. The village contains a number of different areas where the various inhabitants live and where typical day-to-day activities can be carried out (e.g. there is a town hall that is used for gatherings, there is a school, there is a marketplace, and so on.)

On beginning the game, each student-player is assigned a particular character with a certain backstory, and this character is more or less retained for the entire duration of the student-player’s experience with the Siren game universe. As part of daily life in the village, they will be required to undertake various actions related to maintenance of their characters’ livelihoods, and responsibilities within the village.

Importantly, the player characters will have ongoing relationships with other game characters, including other player characters, and NPCs, and the heart of the gameplay revolves around management of these relationships.

Meta game objectives

In keeping with the core concepts of mutual gain and collaboration, the overall objectives of the meta game shared by all players are to:

- keep the village healthy and flourishing, in terms of development, growth, and attracting new inhabitants
- to minimise negative aspects associated with life in the village, including dropping quality of life, and number of (NPC) inhabitants who move out

Each player also has individual objectives at the meta game level:

- to contribute to the flourishing of the village, in terms of growth and karma
- to experience a number of conflict scenarios that take place within the village (with other characters)
- to demonstrate understanding of conflict resolution strategies in a range of different contexts within the village
- to demonstrate the ability to creatively come up with suitable conflict resolution strategies in a range of different contexts within the village
- to experience and reflect on the consequences of particular conflict resolution strategies through impacts on life in the village
- to participate in advising other player characters on how to resolve conflicts within the village

In summary, the meta game has individual objectives for each player, and the interactions and behaviours taken by individual player-characters towards NPCs and other player-characters will have an effect on the game world as a whole, which affect the village's group objectives for all players.

Note that the meta game should be understood as a *container* for conflict, it is an environment within which various kinds of conflicts can occur. For this reason, we do not specifically link the meta game objectives to learning objectives; the purpose of the meta game is to provide a cohesive experience, system, and motivation for players to continue playing, and specific learning objectives will be addressed in the different mini games. The meta game objectives do, however, ensure that the affordances necessary for learning about conflict resolution, and teaching conflict resolution are present.

Meta game pedagogical approach

Although the meta game itself will not be concerned with addressing particular learning objectives, the styles of learning it invites seems particularly in line with include:

- experiential learning: students' reflections on play experiences form the backbone of this concept, the possible player-character roles will put players in the role of conflict protagonist, and conflict mediator, along with community member/observer of conflicts within the community.
- social constructivism: player's individual life experiences will play into their interpretations of acceptable or desirable modes of conduct within the game, and

at particular points, the technology will incorporate individual players' responses and profiles to make individual differences more salient and relevant, and to adapt the game scenarios to be more meaningful.

Note that both experiential learning and social constructivism often call for the presence of a learning facilitator, to help make sense of learning experiences. Our game, similarly, relies on the presence of a learning facilitator, who will lead discussions after most play sessions to relate in-game conflicts and behaviours to real world conflicts and behaviours.

Meta game technology

The SIREN technical components (Procedural Content Generation, Interactive Storytelling, Agent Framework, and Natural Interaction) can be used to achieve the following objectives in the meta game.

- maintain and update the user model and group model across the mini-games
- determine the sequence of the mini-game experiences, based on the student model and the group model (combined with the conflict management component)
- determine the level setting or initial/goal setting of each mini-game considering the student model, conflict and the perceptual ability
- personalize each mini game's content adapted to the student behavior
- agent technology may be useful when a companion character in the meta-game is in charge of guiding the sequence of mini-games for a student

Mini game: "Village Voices" [temporary name]

Game concept

Village Voices is set within the Siren game world. It is a multiplayer open world game, which is on the surface about survival and prosperity in the village, but on closer inspection is about friendship and reputation management in the village, and mastery of conflict resolution. The world contains characters - mostly players and some NPCs - who are all dependent on one another for survival. In the process of playing, players will be faced with conflicts of different types, they will need to resolve these conflicts using creative thinking, and they will need to advise other players on conflict resolution.

Characters played by students or teachers

- Grain farmer (grain)
- Dairy farmer (cows => butter, milk, cheese)
- Vegetable farmer (vegetables)

- Baker (bread)
- Doctor (heals villagers)
- Tailor (makes clothes)
- Builder (repairs any building)
- Toymaker (makes toys)
- Lumberjack (wood for constructions and toys)

Characters played exclusively by guru status students or teachers

- Village guru

Non-player characters (NPCs)

- Employees of characters listed above
- The system will have NPCs play critical roles when it predicts that student players will probably not engage in particularly conflicts (e.g. racism).
- The system will have NPCs substitute critical roles when not enough students are participating in the game. Note that in order to make this assessment, we need to establish a minimum number of players, which is related also to computer availability.

mood; between players? or the current status of player mood

Communication

- letter (asynchronous messaging)
- chatting (synchronous messaging)
- liking/disliking vote such as Facebook; voting can be applied to play interaction, update social network can be applied to the player
- offline discussion and meetings: we point out offline discussion explicitly because it is bound to happen in settings where players are co-located. Furthermore, co-location is necessary for the *local council* meetings discussed below.

Game objectives

From the the meta game, each student-player will have been assigned the role of a particular villager. For example, one student-player may be assigned the role of vegetable farmer, while another may be assigned the role of toymaker. All of the villagers are trying to survive and keep their livelihoods afloat, as well as contribute to the greater well-being of the village. This is measured in terms of the following meters.

A villager's *livelihood meter* is affected by:

- *effort*: how hard they work to maintain their livelihoods
- *amount of property*
- *number of employees*
- *number of trades*: e.g. services, products, or any current possessions)

- game world events: system generated / procedurally generated events i.e. a broken window in the bakery)
- *business reputation* for workmanship / produce. This is affected by whether or not there are currently rumours circulating about the villagers in question, as rumours impact on perceptions of business ethos, and inadvertently, on prices that these villagers are able to obtain for their produce/services.

Villagers have a *health meter* related to:

- physical health (eating enough, being warm, not being ill)
- happiness (related to personal reputation)
- avoiding boredom

Villagers also have a *personal reputation* related to:

- other villagers' perceptions of the villager
- how much the villager helps other villagers
- how often the villager has served on local councils
- degree of fairness in trading with other villagers
- how often rumours are initiated about other villagers
- number of thefts carried out
- number of damage events carried out
- frequency of firing workers

Each villager is part of a larger *social network* including all of the other villagers (both players and NPCs), which tracks information about people's relationships with one another. This network will be represented in a facebook style, and can be updated manually by the player. After noteworthy events, including conflict actions, or helping other characters, the game will prompt players to update their social networks.

Between each pair of individuals, the social network measures:

- degree of liking
- degree of trust
- degree of perception of fairness
- history of previous conflicts (let's imagine for now that we can come up with an objective heuristics number for this. This estimates the conflict level, and can be used to determine when to intervene, and direction for intervention (i.e., escalating/de-escalating the conflict).
- history of interventions (objective heuristics), for instance, when the player had to take part in the council to solve/intervene in a dispute among two other players
- frequency of interactions (a player might avoid to interact with another player and rather prefers interacting with his/her best friend)

Each player[1] **has a conflict learning meter related to:**

- how many conflicts have been experienced
- how many conflicts they have resolved constructively
    - with the aid of adaptation, gurus, and the local council
    - independently of the aid of adaptation, gurus, and the local council
- the player's degree of creativity in coming up with suitable conflict resolution strategies in a range of different contexts within the village
- whether the player's actions over time indicate reflection and learning regarding consequences of particular conflict resolution strategies
- how much sound advice has been given to other players with regards to conflict resolution - this can be determined by the teacher as well as the system.

Although the game can continue indefinitely, the central objective of Village Voices is for players to achieve *guru* status. This is attained once a player has experienced and resolved some subset of potential possible conflicts, demonstrated a nuanced understanding of different conflict perspectives, demonstrated the ability to creatively come up with suitable conflict resolution strategies in a range of different contexts within the village, and participated in counselling other players in terms of how to resolve conflicts in a constructive, positive manner.

Game play and mechanics

Please note that all of the verbs that appear italicised and in bold in the following text indicate newly introduced mechanics.

At the beginning of the game, all inhabitants of the village are assigned some amount of property, employees, and money by the game system (that determines this in an adaptive manner). The inhabitants of the village pride themselves on being industrious and productive. They busy themselves with ***tending*** to their businesses. They are also internally self-sufficient, and prefer to do business first within the village and only then outside of it. Somehow, they are always short of money, so they keep their money for ***buying property, hiring employees*** and ***paying employees***. ***Borrowing money*** and ***loaning money*** between villagers is possible. When times are tight, they may have to resort to ***selling property*** and ***firing employees***.

But they are often happy to resort to ***trading*** their services and belongings with one another instead of paying in money. Villagers who are in need of particular products or

[1] Note we speak in terms of *players* as opposed to *villagers* here. Also, this learning meter exists at the level of the meta game/hub.

services may suggest a trade of products/services with their own products, services, belongings. For example, the vegetable farmer may find that his roof has developed a leak, so he can ***propose a trade*** of three pumpkins to the builder in exchange for repair of his roof. The villager who has had the trade proposed can either ***accept the trade*** or ***reject the trade***, and must decide within a limited amount of time. In this case, the builder needs to decide whether the accept or reject repair of the roof for three pumpkins. In the case that the trade is accepted, then both villagers are expected to carry out their agreement with another. In the case that the trade is not accepted, the villager who proposed the trade can try someone else within the village who supplies the same service or produce (if such a character exists), or they can obtain the same service/produce from someone in the next village at a higher cost.

Trading is not the only way to obtain products and belongings. Another way is to ***steal***. Note that thefts can occur at any point in the game, they do not just occur in relation to failed trades. Note, too, that it is possible to trade stolen goods.

Opposite to stealing, ***volunteering*** is another way to exchange products with each other.

While many of the villagers are very hardworking, unfortunately effort alone does not lead to good service/products. “Fate” often intervenes, by way of procedurally generated world events. For example, the vegetable farmer may discover one morning that many of his crops were damaged by the freak hailstorm that took place during the night.

But often there is also a surplus of produce/services, and once everyone’s needs have been met within the village, villagers ***provide business to people of the next village*** as well, this time selling their products/services in terms of cash. Pricing is based on supply and demand (and established by the PCG), but is also affected by villagers’ *business reputations,* so it is profitable to keep rumours circulating about oneself to a minimum (more on rumours to come).

As a result of PCG and group profiling processing, which are hidden from the players, it might be the case that surplus produce/services go unsold and and are therefore wasted. For instance, some of the extra tomatoes which cannot be sold to the next village may go rotten. Villagers should therefore also consider village sustainability and not just village growth. For instance, a vegetable farmer who produces surpluses might decide to sell/donate part of her field to a dairy farmer. On the other hand, she could hold onto her land, sell the tomatoes to the next village, and become very rich, but risks becoming a target of jealousy for the other villagers.

Life in the village is unpredictable: sometimes it goes well, and sometimes it is hard. Occasionally, villagers may find that they can no longer sustain their livelihoods. For

example, a doctor may find that everyone has been healthy for a long time, and can no longer afford to buy new medicine. Villagers will typically have three choices in this case:

1. sell off some property (resulting in smaller rates of service/production)
2. fire some employees (resulting in smaller rates of service/production)
3. borrow money from another villager

Note that choice (2) will result in employees being angry with the employer, resulting in a change in the employer's *personal reputation* and also in their social networks, while choice (3) now means that one villager is indebted to another, which will also affect the social network weightings between them.

An altruistic solution to the above might occur if another villager decides to ***donate money*** to the villager who is in financial trouble. In this case, the social network weightings will also probably change in accordance with this act of kindness.

Along with life being unpredictable, social interactions are also not always smooth. Any villager can ***start a rumour*** about another villager, which will spread quickly throughout the town once it has been posted on the town hall noticeboard. These rumours can either be input manually by the player or generated by the system. It is also possible to ***damage property of other villagers***, who may then be prevented from working for a while, until their property has been repaired. In addition, NPC villagers may try and socially manipulate player characters to act in certain ways, through threat of broken friendships and fewer trades.

Dissatisfying trades, thefts, world events, suspicions about who started a rumour (that impact on *business reputations* and *personal reputations*), property damage, broken promises, and social manipulation can lead to *conflicts* arising between villagers. For example, the doctor, who is bankrupt, may decide that no one is coming to her clinic because the tailor has spread rumours about the quality of her medicine. The doctor may, as a response, damage the tailor's equipment. Both the doctor and the tailor will update their social network settings for each other as "unfriendly".

At this point, the villagers can choose to take any possible action afforded by the game as a response. These options will be interpreted by the underlying system as *competitive*, *collaborative*, *accomodative*, and *avoidance* tactics, through establishing how characters change their perceptions of one another in response to an action on the social network. For example, the tailor may benevolently decide to loan the doctor some money, and reinstate a "friendly" setting for the doctor on the social network. The doctor also reinstates a "friendly" setting on the social network. The loan of money in

combination with the positive update of the social network statuses for both parties is interpreted as an *accomodative* solution.

Villagers involved in conflicts can either take an action immediately, or choose to delay their decision action by relying on the advice of others. This advice can come as a consequence of ***consulting the village guru***. The village guru is played either by the teacher, or someone who has achieved guru status within the Siren game suite by completing all of the Siren games to a satisfactory level. The village guru is able to give advice about how to resolve conflicts. The guru is also able to ***cast a magic spell***[2] to create *body swaps,* where for a limited amount of time villagers engaged in a conflict have their lives swapped, in order to experience the effects of each other's actions on one another's lives. The guru's presence and availability is related to how skilled the player has become in terms of conflict resolution. That is, the guru is often "out on business" for advanced players, requiring advanced players to make their own decisions.

Alternatively, the advice can come from the *local council*, who are an ad-hoc assembly of villagers played by student players who decide what course of action should be adopted. When a villager requires conflict resolution advice, she is able to ***call a council meeting****,* which results in the game system selecting (student player) villagers to participate in make-shift local council. The council members then conduct a quick conversation/meeting offline about what course of action should be adopted. The council meeting outcomes are then relayed back to the villager within the game, and the villager can continue playing. Villagers get experience points for participating in local councils, which feeds into their personal reputation, but also furthers their conflict learning meter.

As time progresses, players will end up interacting with many other characters within the village, sometimes in a positive manner, and sometimes in a negative manner. Some of these interactions will lead to conflicts, and some interactions will be aimed at defusing conflicts. This will impact on their characters' *personal reputations*, their social network health, indirectly on their livelihood meter, and on their conflict learning meters.

As mentioned earlier, the game can be considered completed for a player once s/he has achieved *guru* status. If the PCG components determine that players have not engaged in certain conflicts, and that conditions within the village make it unlikely that certain conflicts will arise between players, NPC villagers will be introduced to trigger

[2] This will basically be a video replay, it will not be possible to change the course of events during the body swap.

these missing conflicts. For example, a racist NPC villager may start making trouble in the village with player villagers. Note that these NPCs will feature in the social network exactly like player villagers.

The state of conflict interactions overall will have an impact on the prosperity of the village. If there is a lot of poor conflict resolution, NPCs will begin to leave the village. If there is too much poor conflict resolution, the village's crops will wither and animals will run away.

Learning Objectives

Village Voices supports many of the core Siren learning objectives. In terms of abilities, it supports:

- **Perceptual: the students should learn how to see an issue from different perspectives.**
    - The game creates conditions in which conflicts arise frequently. One of the conditions for achieving "guru status", or completing conflict learning is that the game must have registered that the player has experienced the same kind of conflict from at least two perspectives, for some number of core conflicts.
    - Perspective taking will also naturally take place through the body swap spell cast by the guru.
    - Game sequences of conflicts involving villagers can be recorded and played back to the class for the purpose of discussion once the play session is over.
    - Finally, at a mediation level, perspective taking occurs through discussion undertaken as local council members.
- **Emotional: the students should learn how to recognise the distortion effect that strong emotions have on an issue.**
    - Participation in local council requires third party understandings of conflicts. These are less likely to be as emotionally distorted as the understandings of parties directly involved in conflicts. As *Village Voices* requires everyone to participate in local councils, their experience of conceptualising conflicts of other characters in less emotionally loaded terms may lead to them developing a better ability to recognise the distortion effects emotion has on their own conflicts.
- **Communication: the students should develop skills in expressing one or more parties' perspectives or feelings on an issue, particularly when these perspectives are different from one another.**
    - Communication skills are developed through describing conflicts to the guru.
    - They are also developed through adoption of resolution strategies, particularly collaborative strategies, as these require collaboration and communication between parties involved in the conflict.

    - Finally, these skills are honed through participation in local councils.
- **Creative-thinking: the students should develop the ability to come up with a variety of conflict resolution options.**
    - Conflict resolution options are left in the hands of the players, and not (for example) immediately offered by the game via a selection menu. The guru may suggest options that are known to be viable, and the system will create environments that facilitate a number of options (e.g. there will be a "safety net" such that it is not possible to be completely destitute). However, the construction of choices is left in the hands of the players. Note that because the same action can be perceived as competitive in one context and collaborative in another, players are always required to update their social networks after taking conflict resolution courses of action, as this provides a context for determining whether the action taken was competitive, collaborative, accomodative, or avoiding.
    - Local council participation also ensures that students will have the opportunity to come up with conflict responses through discussion with one another.
- **Critical-thinking: the students should learn objective criteria for choosing between options and have experience with developing them.**
    - Objective criteria will be directly introduced via the guru.
    - They will also be indirectly experienced through the progression of the game, and the long-term impacts on the gameworld and their characters' lives.

Pedagogical Approach

Like the meta game, *Village Voices* relies largely on experiential learning and social constructivism as underlying theories of pedagogy. Through the basic game play, student players end up needing to engage in the game world and with it's characters, as well as to enact and resolve conflicts that emergently arise.

As the gameplay is open-ended, facilitation of learning is necessary. This can take place through in-game exchanges with the guru, local council participation where students themselves make sense of experiences and situations, and post-game discussion sessions which involve a teacher and students re-examining in-game recordings of conflicts enacted by student players during the earlier game session. We expect that the game will be supported by supplementary teaching and learning materials. These will draw connections between potential conflicts that can arise in the fantasy game setting, and how these relate to conflicts that can occur in and around a school setting.

In keeping with a social constructivist pedagogical framework, we therefore envisage that while the lessons that children learn will gain salience through being directly experienced in the game world and discussed in groups, there will also be a strong role for the teacher in informally guiding children's learning. This will be achieved by means of a period of planning before the game is played, and a period of reflection afterwards

(see the section on “Recommended play session duration” below) as well as in-game consultation as a “guru”. If they are to carry out this role properly, teachers themselves will need training before they administer the game to children: the section on “Vignettes/user story for a teacher” is an example of the sort of material they might find useful for understanding the game.

How concept maps to user research

Village Voices essentially aims to create a multiplayer open world in which community members are forced to interact with and rely on one another, as the skills of each villager are required by other villagers. In order to broaden the range of possible conflicts, the players’ explicit tasks have been limited to livelihood management. Many of the actions that can be conducted in the world could lead to conflicts, depending on when and how they are used.

For example, competitive trading, trade blocking, social network manipulation, and ignoring villagers are all possible intentional actions in the world. In addition, players can adopt more straightforwardly aggressive actions, including theft, rumour spreading, and damage. These actions were included to echo the user research findings surrounding conflict themes of jokes going wrong, deception, friendship, property disputes, theft, damage, and third party interventions (as villagers can choose to intervene in other villagers’ conflicts). Additionally, almost all of the responses that were documented in relation to these conflicts, short of physical violence, are possible in *Village Voices*.

Two themes that may be less likely to emerge are cultural insensitivity and teasing. NPC villagers may be used to instigate conflicts related to racism and teasing, but more generally, to instigate any other conflicts that should have been experienced by (and between) players but were not.

Recommended play session duration

The Siren games are designed to be played over a number of sessions over a number of weeks. We recommend that sessions surrounding the Siren suite last for a minimum of 30 minutes per session, for a minimum of 8 sessions, and preferably around 20 sessions. Note that each session will include:

- an introduction by the teacher
- time spent actually playing the game
- post-play debrief and discussion including watching play session recordings

Vignette/user story for a teacher

The teacher begins the class session in the computer room by reminding the students of some of the things that happened in the Siren game world last Friday: huge amounts of theft, vandalism, villagers moving out, the crops dying, and cows running away. Some of the students laugh. The teacher says that she hopes this time they will actually try harder to work together. She also casually mentions that in her other class, some students are well on their way to achieving guru status, as she is well aware of the rivalry between this class and the other class. The teacher then tells her students to log onto the game, and that they have the next 20 minutes to play, after which they will have a post-play discussion.

The students begin loading up the game on their separate computer work stations and logging in. The teacher herself goes and sits at a computer work station and logs in. The game welcomes her back and presents her with a stats view of what conflicts have taken place in the game world, and between which characters. She scrolls through the view to remind herself of the events that have taken place in the village. The game also presents events that will trigger just before the current session begins: a draught will cause the farmer and the baker to have much less produce than they had in the last session, and NPC villagers will start spreading rumours that the baker is actually very rich and is hiding her extra produce. The teacher could cancel or change the rumour; the system suggests that the baker is expected to be treated with suspicion by most other villagers, and because she feels that the baker has not been active in a lot of conflicts lately she chooses to keep the system's suggestion. However, she chooses to change the event into a storm that has destroyed the baker's house, which now needs repairs. She knows that the boy playing the builder is very popular in class, and wants to see how his character and the baker's character will handle the situation, and whose side the town council will take in the case of a conflict. The system suggests that her chosen storm event will place the baker and the builder into intense conflict: perfect! Once she has finished reading and is happy with the events, she selects the "Begin Game" button, which drops her into the 3D game world, inside a small cottage, belonging to the village guru: she is the village guru. She waits for the first villager to turn up seeking conflict related advice. The game often requires a lot of waiting, so during this time, she uses the game system's event tracker to see quickly who is doing what in the game world, and what conflicts might be on the horizon. "Let's have our meeting back here", a voice suddenly says. The teacher turns around to see that a local council meeting is forming at the back of the room. The students huddle together and begin quietly discussing a conflict between a dairy farmer and the toymaker. She turns back to her screen to see that the baker is standing in her cottage. "I need some advice", says the baker to the guru. "The builder broke his trade agreement and never fixed my window". The teacher quickly searches the builder's history of actions to see whether there are any obvious reasons why this might be the case, and notes that he is

practically bankrupt. “Have you tried talking to the builder about this?”, the guru asks the baker. “No”, responds the baker. The conversation continues...

10 minutes later, the teacher claps her hands and says “Time to log out!”. There are some sounds of complaint from around the room. “And hurry up!”, she adds. Once everyone is logged out, she loads up a replay video of a theft sequence involving 2 players in the class - the grain farmer sneaked into the baker’s cottage and stole all of the baker’s bread, which was followed up by the baker refusing to trade with the grain farmer, leading to the baker buying flour from an out of town villager, elevated bread trades for everyone, and life being a bit harder for all of the villagers. “You shouldn’t have done that Alan! You spoilt it for everyone!”, says Irina angrily. “It was a joke! I just wanted to see what she would do! Bakers bake bread all the time, don’t they?” protests Alan. “Well, it wasn’t funny and I’m not trading with you anymore”, says Laura to Alan coolly. “Can you guys please make up? It’s making it difficult for the rest of us”, pleads David. “What is the right thing to do here?”, asks the teacher. The class begin an animated discussion that continues until the bell rings.

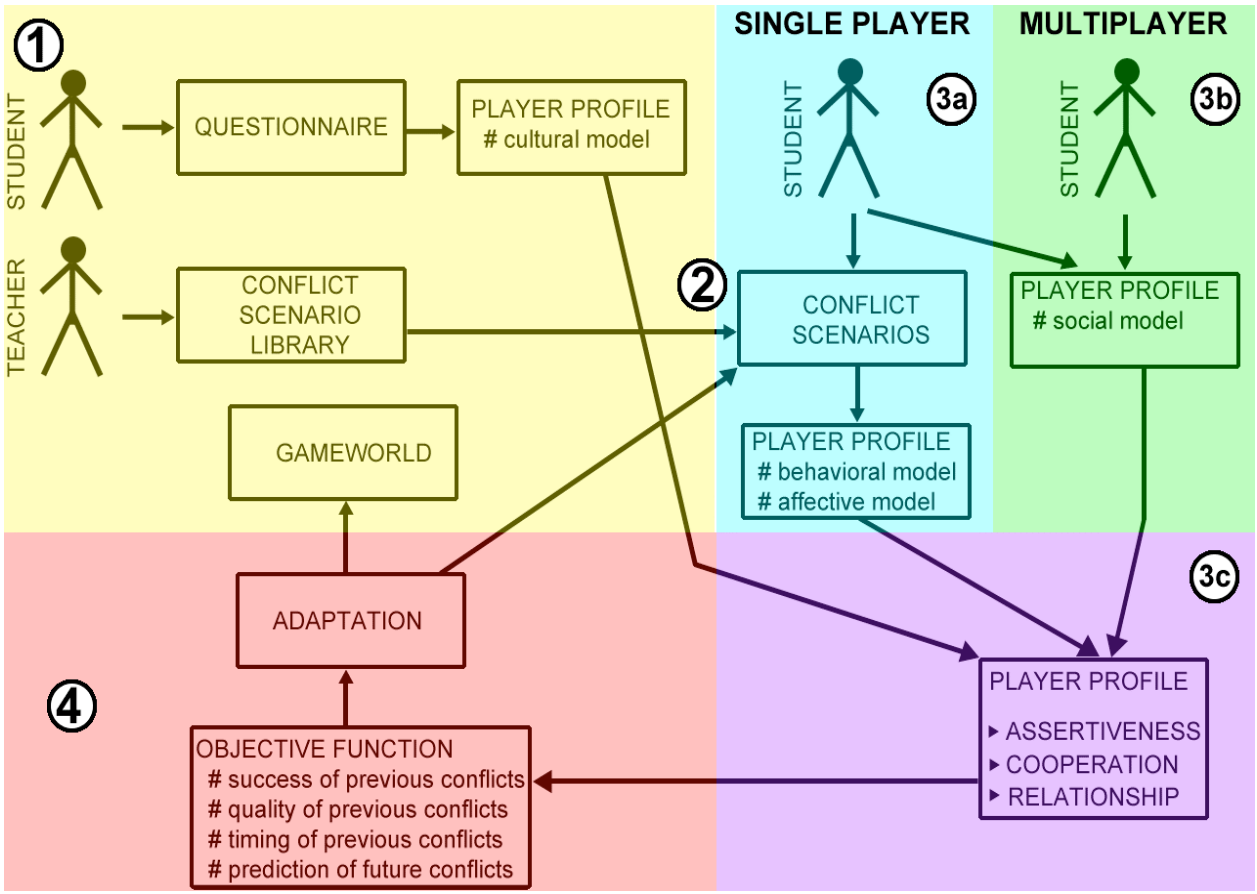
Vignette/user story for a student

Laura begins logging into *Village Voices*. A screen pops up, showing her recent stats about her character, Ginny the baker. It has been a few days since she last played, so she immediately goes and looks at her social network to remind herself of what has happened in the world. She sees Irina, her best friend in real life, also listed as her best friend in the game world as Isabel the toymaker. She has a chuckle, because last week it seemed like the game world was trying to tear them apart. For a start, Isabel had become friends with Alan in the village, who played the grain farmer. In real life, both Laura and Irina had a sworn hatred of Alan! She had also had a string of bad luck in the game, and had ended up owing lots of money to the toymaker, but fortunately the toymaker had helped her out a lot in the game - by donating money and labour - and the resentment towards Irina’s character died down. Laura notices that she would be able to buy a new oven - and bake bread faster! - if everyone who owed her character money repaid their debts. Once again she notices the broken window in her cottage, that left anyone who came to buy bread feeling cold. She feels irritated that the builder, who had promised to fix the window in exchange for bread had not upheld his promise. She had given him bread, but he had never fixed the window. After the recent storm, and the new damage done to her roof, she really could use some repairs from the builder. But what to do? Laura makes Ginny walk to the builder’s house to try and do something about the window, but he is out. She then decides to go and see the guru to find out what to do about her outstanding debts. She enters the guru’s cottage, and the guru is sitting on an armchair next to the fireplace. She makes Ginny request help, by having Ginny say: “I need some advice”. “The builder broke his trade agreement and never

fixed my window”. After a few seconds, the guru responds. “Have you tried talking to the builder about this?”. “No”, responds Ginny. The conversation continues...

A few minutes later, Ginny walks back to the cottage, resolved on helping the builder with whatever is going on. She opens the door and notices that strangely, all of the bread is gone. There were seven loaves on the table before she left, and now there are none. Has there been a theft?? She leaves the cottage and runs into Isabel, who is carrying a loaf of bread. “Did you take that from my house??”, she leans over and asks Irina, starting to feel confusion and irritation. “No! I got it from Alan - he stole all of your bread and is now trading it with people. I traded this for a toy and was coming to give it back to you. “Thanks Irina”, says Laura, and Isabel hands over the bread to Ginny. Laura feels furious. Absolutely furious. Now she has practically nothing left to trade with, and she and her employees will have to spend a long time baking new bread. And... flour! Alan is the grain farmer and she will need to trade with him to get flour! She immediately downgrades the grain farmer to being her least favourite person in the *Village Voices* social network. There is no way, no way at all that she will do any trades with the stupid grain farmer. Instead, she orders flour from the next village, knowing that it will cost more, and borrows money, again, from Irina. Lucky that they are such good friends in real life! She will just have to raise bread trade cost more temporarily in order to make returns on the cost of the expensive flour from out of town, and also the stolen loaves. She considers spreading a rumour about the grain farmer by posting a notice about how he is a thief on the noticeboard next to the town hall. It wouldn’t even be a rumour, it would be true!

System Components



The suggested framework, which applies primarily to ITU's minigame but can potentially be extended to fit other minigames as well, is expected to follow the following high-level process:

3-4 types of user model from off-line training and then be personalized

1. ***Initialize*** the gameworld including conflict scenarios with hand-crafted content (or hand-picked among generated ones). A cultural model is also initialized during this phase from a survey answered by the student-players. The objective functions and player models which evaluate the content to be adapted are also initialized based on existing literature and verified through questionnaires and early playtests. The TKI questionnaire[3] will also be used to infer initial cooperativeness and assertiveness values for the students. The gameworld is created and the list of conflict scenarios that the teacher would like to use in his class is defined -- this ensures that teachers retain control of the conflict experiences in cases of cultural sensitivities for particular schools.
2. All (or a subset of) ***initial conflict scenarios are played by each player*** (or a group of players in a multiplayer environment).

[3] http://pascentre.com/admin/files/printable/English_PAS_2-TKI.pdf

3. Based on the interaction of the player with the game (3a), the other villagers (3b) and its scenarios, ***individual player and group models are derived*** (3c). While the cultural model remains the same, the affective, behavioral and social/group models are continuously updated during this stage. A history of the gameworld and its non-player characters (and their interactions with the game and the players) is logged in order to provide a consistent narrative.
4. The ***adaptation of the gameworld and of future conflict scenarios*** is based on one or more of the criteria in the adaptation policy (see section below). The player and group models, and gameworld history inform the changes made to the gameworld and the scenarios. The objective function of the optimisation process is further described in the relevant section below.
5. Steps 3 and 4 are repeated in sequence, until the intended learning objective is met (as validated by the teacher and the system).

Adaptation policy/criteria

1. Adapted to the context of the ***current state of the gameworld*** (such as non-player characters currently in the game). This is an important issue if components of the gameworld (map, non-player characters, events) are all procedurally generated: the issue of content consistency is handled by this criterion.
2. Adapted to the ***history of the gameworld***: past instigated conflicts, past events or past NPC experiences. While relevant to criterion 3, this criterion will only cater for past events not explicitly tied to the player.
3. Personalized to ***the player's history of previous interactions and conflict-related experiences***. This criterion intends to create a consistent tie-in with previous events and shift the player's resolution strategies towards the intended ones as specified by the teacher or game designer (see criterion 5).
4. Personalized to the ***player's relationship with other players*** within the game (assuming a multiplayer environment); the adaptive content can be used to resolve outstanding conflicts (or past misunderstandings) with another player, or instigate more conflicts between players that have easily resolved past conflicts in order to enhance the positive psychological reward or test the player's ability at avoiding conflict. The players included in the instigation of resolution of conflict can also be hand-picked by the teacher, based on either in-game observed behavior or transgressions outside of class (see criterion 5).
5. ***Authored by a teacher before/during each play session***. As teachers may want control over the created interaction (also on the grounds of different cultural and personal sensitivities in different countries or institutions), before each session the framework can suggest one or more conflict scenarios defined and

modelled as per the previous criteria. The teacher can make small or large adjustments to these scenarios either through direct human-machine interaction (parameter tweaking) or indirectly by giving a high-level learning objective which becomes an additional constraint or evaluation which guides the adaptation of generated content. E.g., PCG can inform the guru of upcoming events

Procedurally Adapted Parameters

Certain smaller conflicts can be used as-is, adapting the two parties being drawn into the conflict without altering the possible paths for resolving the conflict: this approach is best suited for simple conflicts which have a clear message and can be applied to multiple situations.

In the context described above, some of the simplest (or minimal) adaptive features are:

- **Characters** involved in the conflict (and their corresponding identifications -- usually names). The characters involved can be Player Characters (PCs) or Non-Player Characters (NPCs).
- **Instigator of conflict**: this can be loaded from a library of such conflict scenarios, suited for the current needs of the characters being involved.
- Dialogue options or available actions for the resolution of the conflict: these can be explicitly tied to the scenario chosen to instigate the conflict, or adjusted according to the current requirements of the learning exercise/desired experience. For instance, the most immediate/obvious or most oft-chosen option can be made unavailable.

Large-scale conflicts which require internal and external consistency have many parameters which must be adapted to the current gameword's and players' needs. Parameters in these cases include the initial state of the world, the choice of participating parties in the conflict, choice and timing of events which either hinder or facilitate conflict resolution, action or dialogue options and the final outcome of the conflict (including the intended morale of the conflict).

In the context of a larger-scale narrative, adaptive features can include:

- **World events** that effect either PCs or NPCs, instigating further conflict or resolving existing conflict. An example would be the occurrence of bad weather, which can destroy a farmer's crops and require them to borrow from a character which has plenty of resources but does not like to part with it. Either of the characters (farmer or loanshark) can be a PC or an NPC, or both can be PCs.

World events can include:

- Game setting parameters
  - item production rate, item quality.
  - quantity of extra produce being sold to the world beyond (we call this the *next village*).
- Scenario related
  - weather and incidents such as storms, disease, lottery winning, etc.
  - quests as suggestions rather than goal (e.g., buying a bigger oven for baker, etc). Note that this may in turn influence the PCs' behavior.

- **NPC behavior** in tune with past players' actions, which can affect the Player Character positively or negatively. Unlike events, which should not be perceived to be causally linked to player actions, the NPC behavior is supposed to be a direct indication of an abstract moral sense of right and wrong and should reflect indirectly the damage that aggressive approaches to conflict can do to a society.
  NPC behavior can include:
  - NPCs as employees: resigning, current item production
  - NPCs as villagers: all actions available to villagers (e.g., trading, starting rumors, property damaging, stealing, the barter prices of different NPCs with each player, dialogue options)
  - NPC as guru: intervene in the conflict situation when it's too high (e.g., giving suggestions), direct the player toward other mini-games

For NPCs, we can use various approaches to generate agent behavior such as behavior trees, Bayesian Networks, and logical reasoning inference. Initially, a NPC model is given as a structure of tree, rules, a Bayesian network, and more sophisticated frameworks such as FatiMa.

In the case of **world events**, the total conflict of the environment can be used as a key element to determine when to intervene and the direction of the intervention. When such a heuristic is very low, a world event can try to escalate the conflict; when the number is too high, a world event can try to de-escalate the conflict. The heuristic can be built from the intermediate parameters obtained by estimating the student emotion and in-game performance.

For the crop growth rate, quality, weather change, disease outburst, and initial settings can be determined by evolutionary algorithms and artificial neural network models. First, the system models the relationship between game parameters and a parameter representing the degree of conflict. Also the system can intervene to maintain the balance in reputation to keep the game continue.

Objective Function

Using data-driven approaches, we expect that we can train a conflict escalation/de-escalation model that receives a specific setting of procedurally adapted parameters and outputs if the setting would escalate the conflict or de-escalate the conflict. Ultimately, we aim to find the optimal setting to control the conflict so that opportunities can be given to the students to learn conflict management skills.

<table>
<tr><th colspan="7">Procedurally adapted parameters</th><th></th><th>Conflict</th></tr>
<tr><th colspan="4">Directly adaptable parameter</th><th colspan="3">NPC goal adjustment</th><th></th><th rowspan="2">Escalating
De-escalating</th></tr>
<tr><th>Item production rate, quality</th><th>Overproduction being sold</th><th>World events</th><th>quests</th><th>NPC as villager</th><th>NPC as employee</th><th>NPC as guru</th><th>→</th></tr>
</table>

The adaptive content can either **(a) instigate a new conflict, (b) aggravate or (c) resolve an existing conflict**. (a) and (b) fall in escalating conflict and (c) falls in de-escalating conflict.

The expected response from the player is in all of the above instances a commitment to the resolution of the conflict.

- In the case of (a), the resolution of a conflict which has just been instigated is treated as a success of the adaptive content: the goal was to create a conflict that is of interest to the player and if the player follows the lead provided then the goal has been attained.
- In the case of (b), if the player continues to take steps towards resolving the conflict but takes more “steps” towards resolving it than anticipated before the aggravation was applied, then the goal has been attained; if the player does not take steps towards resolving the conflict after it has been aggravated, then (c) should be applied. The term “steps” is intentionally abstract and depends on the type of conflict and the methods of its resolution: for a dialogue-based example, the number of dialogue sequences would be the number of “steps” in question.
- In the case of (c), if the player takes steps towards resolving the conflict, but takes less “steps” towards resolving it than anticipated before the adaptation was applied, then the goal has been attained. In most cases of conflict resolution through (c), the solution to the conflict should become more easily attainable or more easily apparent rather than being resolved automatically by the computer alone; some help from the player should in most cases be necessary towards ending the conflict scenario. Exceptions to this rule can apply to cases where the conflict is simply ignored by the player -- in such cases the instigated conflict is considered a failure and is quietly resolved by the computer alone.

As an optional evaluation component, the quality of interaction between the player and the conflict scenario can be used: if a conflict scenario is supposed to lead the player towards a specific behavior (be it good or bad), if the player operates according to this expected behavior, then this secondary goal has been attained; this applies to all three objectives (a), (b) or (c) of adaptive content.

Adaptation towards escalating conflicts

Then, the system can intervene the gameplay if necessary. If the system predicts that the player would employ a collaborative strategy (as seen in the table below) in the escalation phase in the following figure and it is likely that he would end up having no conflict experience, the system can adapt the parameter to invoke a situation potentially generating conflicts.

Adaptation towards de-escalating conflicts

On the other hand, if the system predicts that the player is either having high negative emotion such as anger or is pursuing competing strategy in the de-escalation phase where conflict resolution is expected, the system may present a setting that would be easier for the player to take actions toward conflict resolution.

The conflicts can be modeled (and parametrized) in many different ways, depending on their complexity, estimated playtime and intended learning objective. Tentatively, we can define the villager's conflict intensity as follows.

Each villager's conflict intensity can be estimated using:

- level of negative emotions (e.g., frustration, anger, anxiety, etc)
- how many conflicts have been experienced
- number of ongoing conflicts that have not been resolved yet
- frequency of harmful actions (e.g., rumors, damaging, stealing)

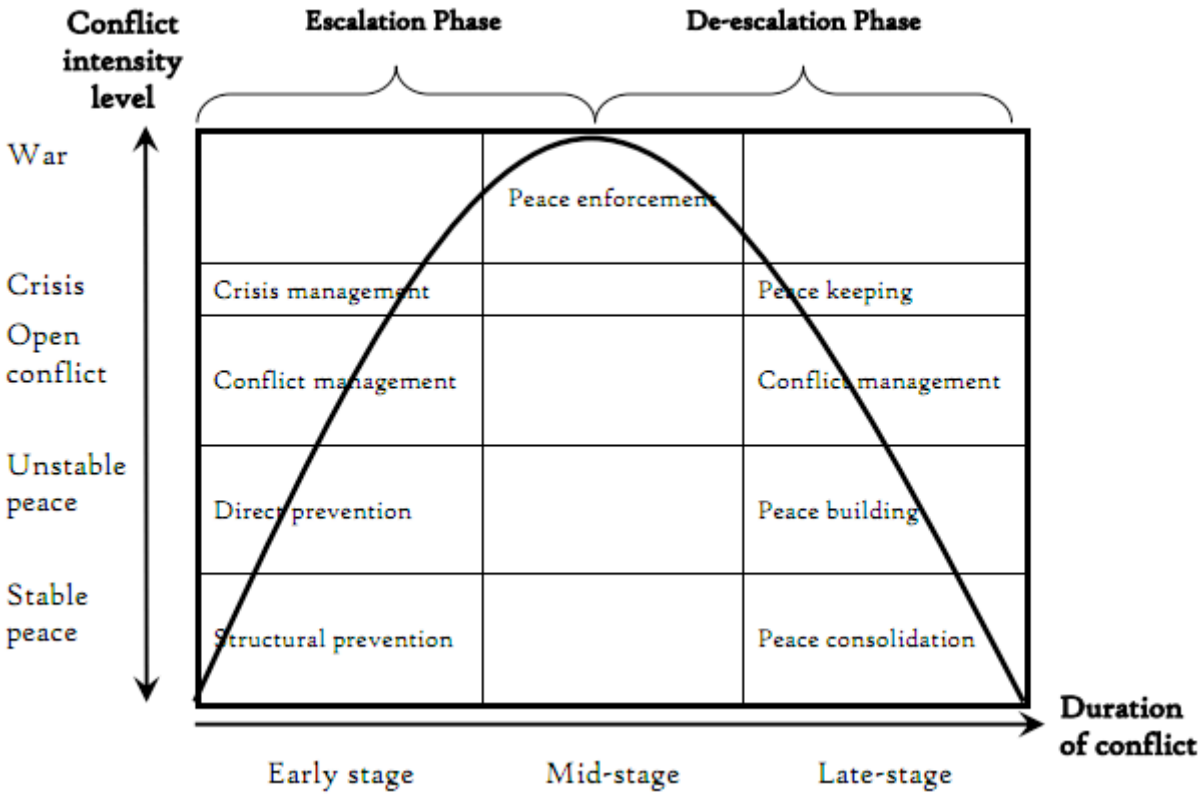


TABLE. Conflict Management Style prediction based on assertiveness/cooperativeness/relationship

Management	Assertive	Cooperative	Relationship
Collaboration	+	+	+
Collaboration or Competitive	+ +	+ -	- +
Competition	+	-	-
Accommodation	-	+	+
Accommodation or Avoid	- -	+ -	- +
Avoid	-	-	-

In order to find the optimal setting for conflict control, we may use two objective functions. Conflict Escalating objective function (CE) and Conflict De-escalating function (CD). The goal of the adaptation technique is to find the setting that maximizes CE or

CD. When the player is likely to have no conflicts during gameplay in the escalating phase, the system uses the CE function. When the player takes aggressive actions in the de-escalation phase, the system can use CD to generate the optimal solution.

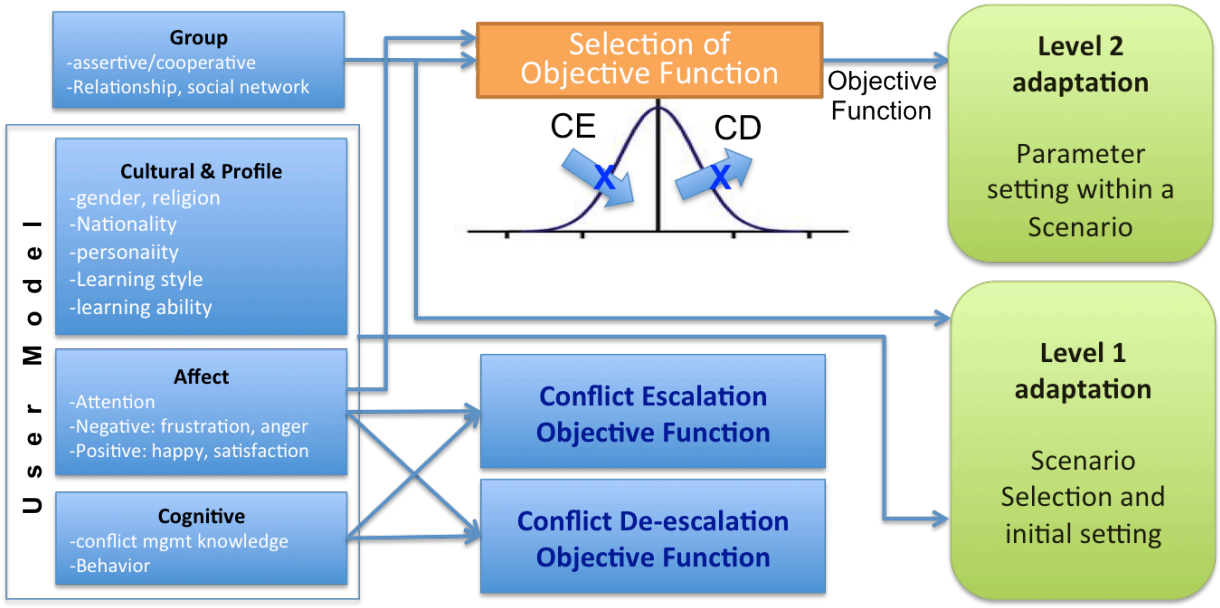
CE = level of negative emotion (anger, frustration, anxiety) + number of conflicts (resolved and ongoing with more weight on ongoing conflicts) + harmful actions (rumors, thefts, damage)

CD = level of positive emotion (happiness, satisfaction, empathy) + reputation + fairness + trust + liking votes

Note that emotional status can be estimated through the player's behavior in the game environment as well as from the natural interaction component. For instance, the player can visit the guru's cottage when she feels frustrated and needs to be advised; she may feel anxiety when a number of conflicts remain unresolved; she may take harmful actions when she feel angry.

Two layers adaptation scheme in relation to User Model and Group Model

The goal of the adaptive content is to procedurally create a conflict scenario and set the game environment which fits both to the current and past states of the gameworld and to the current and past playstyles (options taken, relationships built) of the players involved towards the best game experience in terms of learning conflict management skills.



To this end, we design the adaptation consisting of two layers: scenario selection layer and game parameter setting levels (See figure above). At the first level to select

appropriate scenario for the player, the system considers the player's user model (e.g., cultural background, cognitive ability in conflict management based on the history of performance across various scenarios, learning style) primarily. In addition, her relationship with other students to can be considered to find co-players for the multi-player mini-game. Furthermore, when a relevant scenario or mini-game is chosen from the pool of predefined scenarios, the system can find the optimal initial setting for scenario parameters.

At the second level adaptation, during the game play withing a chosen scenario, the system periodically evaluate the player's status and can create procedural contents for intervention if necessary.

Game Parameters for evaluation

- **Parameters which can be obtained directly from the virtual world without complicated calculation or estimation**

    a. primitive character actions
        ■grow/make/produce produces and crops
        ■selling/buying properties
        ■steal / damage property
        ■start a rumour
        ■borrow money from another worker
        ■hiring/paying/firing employees
        ■propose/accept/reject the trade
        ■request advice from guru / give advice
        ■call a council meeting / participate in local council
        ■guru can cast a magic spell (perspective change)
    b. game meters
        ■quests completed
        ■livelihood meter, health meter
        ■personal reputation, social relationship, conflict learning meter
    c. student profile
        ■gender, religion, culture, nationality, age, verbal skill
        ■learning preference (favorite subjects, achievement vs. mastery, etc.)
    d. various game statistics
        ■student's response time (mouse click, key press, etc)
        ■student trajectory in the game world

- **Estimated Parameters**

a. emotions
- ■attention
- ■gesture (hand, head)
- ■frustration, peak emotion (anger, anxiety), satisfaction or happiness for conflict
- ■flow, motivation, frustration for education
- ■engagement (or off-task behavior), boredom
- ■empathy towards other players

b. conflicts
- ■cause of conflict: competition for resources, relationship difficulty, norms and values, attributional biases

c. student profile
- ■personality
- ■conflict related values: assertiveness, cooperativeness, aggressiveness
- ■learning preference (learning/having fun/ exploring, etc.)
- ■relationship
- ■empathy

Game flow diagram [to be determined]

Locations/maps [to be determined]

- different kinds of farmlands
- one location for each character (e.g., bakery / doctor's clinic / toy store / tailor shop / builder's shop)
- town hall for council meetings / town square for trading
- guru's cottage

Graphical style [to be determined]

Audio [to be determined]

User Interface [to be determined]