

# The Effects of Trust and its Relationship to Learning in the 3-D Virtual Learning Environment of Second Life

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## Summary

Virtual worlds come with a promise to transform the learning and teaching paradigm, making collaborative and immersive learning more accessible and tailored, depending on the needs of the students and teachers worldwide. Platforms such as SL provide essential tools for enhancing the virtual learning experience such as smartbots, imbedded NLP, SLoodle etc. However, in order to replace traditional classroom environments in a reliable manner for rendering effective teaching operations some essential investigations are still lacking in literature. In order to make a switch, one of the most important bottleneck is the ability of VVs to ensure real traditional classroom like trust in student-teacher interactions. In an attempt to make VVs more accessible and usable as a replacement, this research attempts at bridging the seemingly increasing gap in two worlds. Hence, established ways of investigations in both the research domains of virtual worlds and traditional pedagogy are brought closer to identify the requirements for VW platforms such as SL to act as a reliable replacement for traditional university classroom, ensuring trust and effectiveness. In a similar fashion, the tools and techniques available for integration in SL are analyzed which can act as a bridge. A trans-disciplinary approach is taken in which the identified requirements of a traditional classroom specifically in terms of trust in student teacher relationship, are transformed for an SL classroom using SL capabilities and other identified mechanisms such as AI, NLP, smartbots, virtual designs, possible authentication and security layers etc. Practical implications of identified requirements are tested as a prototype in SL to provide a one stop solution for all future educators.

## Keywords:

*Virtual World (VW), Secondlife (SL), Natural Language Processing (NLP), Artificial Intelligence (AI), Virtual Reality (VR)*

## 1. Introduction

Virtual worlds, virtual reality (VR), and immersive platforms have considerably transformed teaching and/or learning in the modern world. Virtual learning environments have become increasingly more important within the context of higher education, mainly due to the tools which compose them and to the support they give to students, teachers and institutions. With the help of artificial intelligence and machine learning, virtual learning environments will revolutionize higher education in near future. SL is one of these virtual worlds' platforms

developed by Linden Lab, and launched in 2003, which can be applied as teaching and learning tools and can easily interact with the help of avatar which is the digital persona the teacher and student can create and customize [7].

Currently, SL has become one of the most popular, engaging and advanced virtual environments used in teaching methodologies in several universities in the world such as Open University, University of Edinburgh, University of Derby, University of Plymouth in UK and Coventry University where the students can attend classes, meet each other and create content together [8]. Teachers are considered the main element in the SL environment, making them central to establishing trust; so, they must be trained well to face the challenges of this environment.

In order to have qualified teachers in SL, they must be trained in teaching using communication methods, modern learning tools, and information accessing. They must also be flexible, with high standards of teaching, and they must be able to help and teach students of how to use SL tools and how they can participate in this environment [9]. Furthermore, it is important to understand the importance of dynamics in virtual learning environments as educators are faced with the challenges of learning how their students interact as members of a virtual team. All these elements can be implemented in a VW only if the student-teacher relationship is built upon trust and students can have complete trust regarding privacy, respect and information being delivered in VW classroom. It is also important to understand the construct of trust in these environments, and the impact of trust on learning [10].

Hence, this conundrum regarding the gap in trust building strategies (identified as the central tenant of effective learning in classical pedagogy literature) between traditional classroom and VW classroom is filled in this research through an inductive approach, using both data gathering and experimentation (as a proof of concept) techniques. The established model can be replicated for trust inclusive VW classrooms in the future.

Considering the inflection point the research problem is established keeping in view the challenges arising from the lack of face-to-face interaction in VVs. SL is chosen as VW platform for proof of concept. In the SL, teacher and student have the ability to create their avatar as they wish

which brings into mind the issue of trust within this communication process. Although there has been a considerable increase in the use of SL virtual world in education methodologies, little is still known about its limitations and strengths as learning environments [2, 4].

Therefore, there is a need for exploration of the new techniques and ways in which trust is perceived and built in virtual environments. As well as, there is a requirement to create interactive and collaborative virtual classes in this environment.

This research aims to contribute to a better understanding of the function of trust in virtual environments, and how to integrate trust into virtual classroom environments based on time tested techniques extracted from traditional pedagogy. Such that, trust can help students engaging in experimentation, exploration and activities. Also, the research helps to create an affective collaborative learning teams or communities by using smartbots, controlled by using SBSL (SmartBots Scripting Language) and machine learning algorithms.

There are many previous studies showing that SL has enhanced the social and emotional sides which are the most important aspects in making education much easier, more efficient and more interesting. Along with that, SL enhances students' experiences and improves student engagement [11].

## 1.1 Research Objectives

1. To investigate, through multiple data collection methods, the trust building techniques, their impacts in classroom and their utilization in VWs.
2. To investigate and conceptualize the use of multiple technologies ranging from natural language processing in artificial intelligence (through smartbots) to use of connected mobile devices for biometric authentications.
3. To investigate into the use of state of the art tools in VW classroom, which can allow the integration of identified teaching techniques.
4. To create virtual classrooms in SL that support trust and interactive techniques for building an effective virtual learning environment. Thus, teacher and students can build trust through smooth interactions and participate in different projects and courses.
5. To investigate the perceptions of students and teachers towards using the SL platform as an educational tool for enhancing their course experience, interactivity and increasing trust in their relationship.

## 1.2 Rationale

Given that the identified research objectives are bold in a sense that no such study has been carried out to bridge the gap between traditional and virtual classrooms, specifically from the perspective of trust, an equally bold approach to data collection and analysis is utilized. This was identified as the biggest need of the research discipline as teaching community is going through a radical transformation.

Learning in VWs is comparatively new and the literature in the subject is constantly evolving, hence, encapsulating the dynamics of the VW classrooms is an overwhelming task. In that regard, the focus is on the analysis and extraction of state-of-the-art techniques and tools that can be used to fulfil the requirement of effective teaching techniques from the perspective of traditional classrooms.

In order to make sense of the complexity the knowledge base is constructed for the study in two parallel stages of data collection and analysis. The first stage is based on analysing content from literature and conducting survey and interviews to understand the requirements of teachers and their understanding of the role of trust in the classrooms, both traditional and virtual. This stage formulates the theoretically underpinnings of the study.

In the second stage of data collection, techniques such as case studies and content analysis from online communities are used to understand and utilize the technological features of SL and other state-of-the-art technologies that can better enable the execution of strategies identified in the first phase of the study. At this stage the capabilities of state-of-the-art technologies and tools such as smartbots, chatbots, NLP and others associated SL approaches are analysed.

The two parallel approaches allowed the researcher to define a comprehensive model for teaching methodologies for VW classrooms that may fulfil the theoretical requirements of building trust and delivering content effectively.

A waterfall approach for prototyping is used for the experimentation. One of the biggest contribution of the research is in the form of defined requirements in three separate layers that are transformed in the design features for VW classrooms. Three layers of requirements are identified: Authentications layer, Behavioural layer, and Teaching strategy layer. For each layer firstly trust-damaging scenarios are identified, which are then transformed into a set of functional requirements from where design features for SL classroom are identified. For each layer a separate set of experimentation is conducted as a proof of concept. Table 1 captures the requirements summary.

As a proof of concept an analysis of the results accumulated from the experimentation in SL are

statistically analysed to reach a conclusion if the defined protocols have been successful in achieving the set target. The results are captured in detail in the study and they provide the proof that the identified requirements model is effective and can be followed as a standalone approach for implementing teaching methodologies in VW classrooms for the years to come.

One of the focus understands the complexity related to using technology on student trust. Hence, a very careful consideration is given to make sure that whatever technology is used for SL classroom actually is psychologically influencing the student in a positive manner. One of the biggest conundrum of the modern age is the over and excessive use of technology such as Head Mounted Displays, which might appear to enable better interaction in SL classroom but instead adds greater psychological pressure on students and reduce their overall interest. Although many technologies are exploited through different ways in this study, but the chosen ones for the implementation are only those which actually adds to the aim of building trust and not reducing effectiveness of teachers.

## 2. Tables, Figures and Equations

### 2.1 Tables and Figures

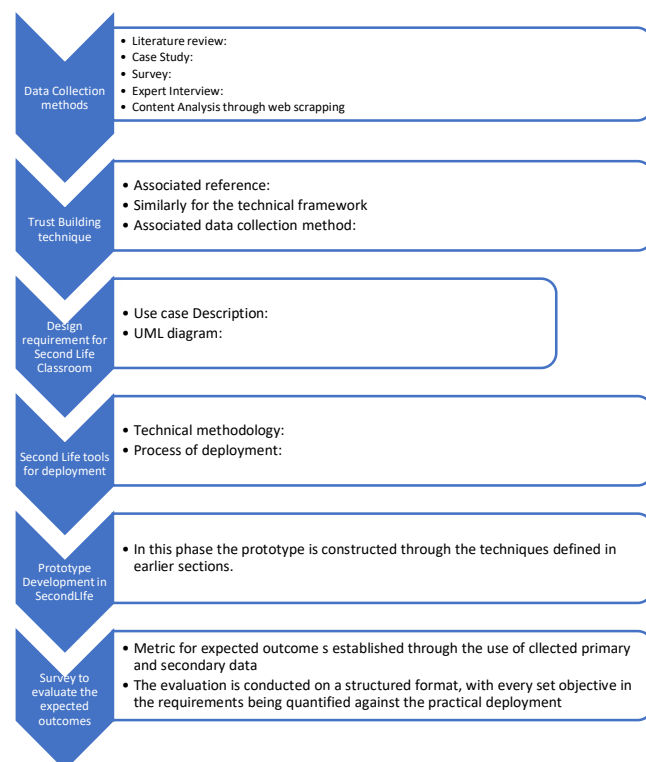


Fig. 1 Methodological Flowchart.

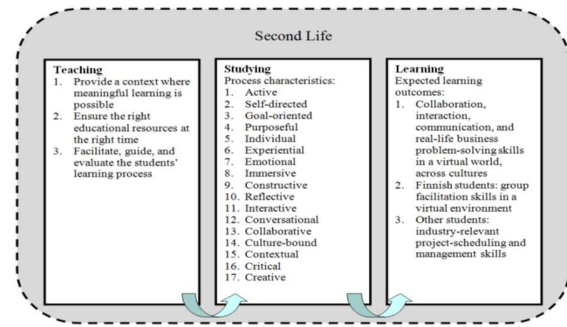


Fig. 2 GloVED model designed for SL.

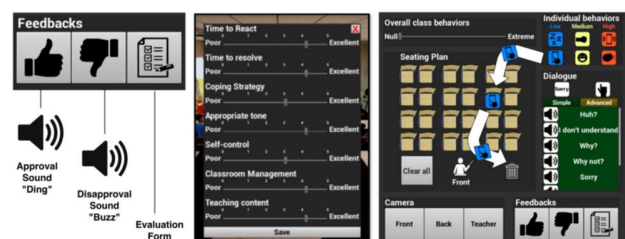


Fig.3 Feedback and Control Mechanism.



Fig.4 Teacher instruction interface.



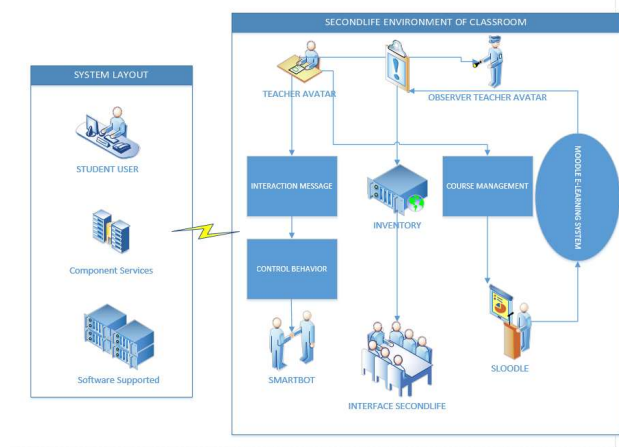
Fig. 5 Empty classroom design based on requirements.

**Table 1:** A comparison of results achieved.

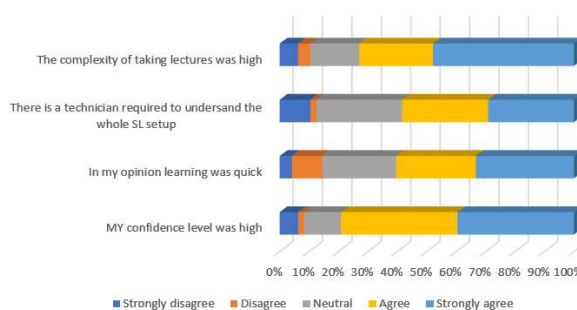
| Requirement layer              | Trust damaging scenario                                                                                                                                                                                                                                                                                                                                                                                       | Functional requirements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Design features                                                                                                                                                                                                                                                                                                                                      | Experimentation conducted                                                                                                                                                                                                                                                                                                                                                         |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Authentication layer</b>    | <ol style="list-style-type: none"> <li>1. Presence of proxy</li> <li>2. Smartbot instead of the student</li> <li>3. Presence of avatar but student is physically absent</li> <li>4. Student doing any other activity while class is being conducted</li> </ol>                                                                                                                                                | <p>Student authentication mechanism for distinguishing avatars</p> <p>Automated mechanism for the mental presence of the student</p>                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p>Provision of secret code for class entrance.</p> <p>Questions prompted through a chatbot during lectures.</p> <p>Questions prompted after a set interval of time</p> <p>Prompts of low level of complexity</p> <p>A 50% mandatory requirements of correct answers for the presence to be marked</p> <p>Team-teaching the course.</p>              | <p>Classroom constructed in secondlife based on realistic designs</p> <p>Tests of smartbots conducted generally for their ability to ask random questions</p> <p>Level of possible intelligence of smartbots tested</p> <p>Chatbots created</p> <p>Addition of voice module to the classroom</p>                                                                                  |
| <b>Behavioral layer</b>        | <ol style="list-style-type: none"> <li>1. Use of abusive language during class</li> <li>2. Use of physical interference through object throwing when teacher is not looking</li> <li>3. Interfering with the teacher movement</li> <li>4. Using voice to interfere with the lecture</li> </ol>                                                                                                                | <p>The behavior of the students in the class is required to be monitored through an automated system.</p> <p>The use of abusive and unethical language is prohibited using intelligent chatbots.</p> <p>The physical behavior of the students is monitored</p>                                                                                                                                                                                                                                                                                                              | <p>Very clear and precise rules of the classroom conduct are presented as an object in the classroom.</p> <p>Behavior control smartbots are introduced which monitor the individual conduct.</p> <p>Smartbots are given instructions for scenarios, which might allow them to relegate the student from the class.</p> <p>Team-teach the course.</p> | <p>Just like support teams who work at multiple destinations in Secondlife, a support member (can be a Teaching Assistant) is allowed in the classroom to oversee the communications among the class members and look for unethical conduct.</p> <p>The support member is given privileges for relegating the student out of the class after giving a set number of warnings.</p> |
| <b>Teaching Strategy layer</b> | <ol style="list-style-type: none"> <li>1. There is a communication gap between teacher and students</li> <li>2. The content being presented by the teacher is in less engaging manner and no effort is done to get the feedback from students.</li> <li>3. The student engagement in the material is very low</li> <li>4. The participation of students into the course material is not encouraged</li> </ol> | <p>The teacher must use understandable medium of interaction.</p> <p>The teacher shall actively engage the students and present scenarios that might stir discussions and debates with their peers.</p> <p>The teacher must allow students to freely raise their concerns and shall prioritize their understanding over the completing the course content.</p> <p>The teacher shall use evidence based learning approaches that might allow students to interact with other students and engage in teamwork activities for realization of the concepts being presented.</p> | <p>An interactive module of Sloodle (Moodle e learning system) is added to the classroom.</p> <p>The teacher is allowed to use blackboard as well as microphones to deliver their lectures.</p> <p>The teachers and assistants are allowed to moderate discussion and chats during collaborative tasks.</p>                                          | <p>A blackboard inked with the course management system is added in the classroom known as SLOODLE (Moodle-e-learning system).</p> <p>The teacher is encouraged to use the techniques of role-play in the classroom and authentic learning techniques.</p> <p>The teachers are provided portals to ask questions during the class session.</p>                                    |

**Table 2:** T-Test results for evaluations.

| Test Query                             | Level of education | Number | P-value | Significance              |
|----------------------------------------|--------------------|--------|---------|---------------------------|
| The classroom was difficult to use     | Post-grad          | 3      | 0.16    | Statistically significant |
|                                        | Grad               | 3      |         |                           |
| The controllability of avatar          | Post-grad          | 3      | 0.51    | Not Significant           |
|                                        | Grad               | 3      |         |                           |
| Safety of teaching in Secondlife       | Post-grad          | 3      | 0.64    | Not significant           |
|                                        | Grad               | 3      |         |                           |
| Teaching methodology selection is easy | Post-grad          | 3      | 0.72    | Not Significant           |
|                                        | Grad               | 3      |         |                           |

**Fig. 8.** Classroom visualization in SL**Fig. 6** Authentication and behavior control layer process flow.**Fig. 7** Teaching Strategy layer process flow.

Trust as assumed by the students

**Fig. 9** Evaluation of experimentation.

### 3. Literature Review

Vast amount of literature is studied and summarized on the subject with an aim to construct theoretical foundation for the research. It is constructed that Trust in virtual classroom environment is a complex phenomenon and there are multiple layers of trust building strategies and techniques, which shall be employed in the design and implementation such that learning performance can be enhanced. For the current study the theoretical foundation of trust in virtual classroom is constructed through the use of literature based on traditional classroom. However, this theory is extended upon the trust related aspects specific to Second Life including identification and authentication, and trust conducive environment of the classroom.

#### 3.1 Theoretical Foundation

In this section, a review is conducted to analyze the trust building factors in a classroom from brick and mortar classroom settings perspective. The selected factors influencing trust between student and teachers are a prerequisite to any other trust enabler tools to be implemented in a virtual environment.



Firstly, it is important to establish a well-recognized definition of trust in the literature. According to detailed work of Rousseau et al. (1998), in which the earlier literature regarding trust and its psychological underpinnings was analyzed, the following holistic definition was established: *“Trust is a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behavior of another”*

It is important to divide the definition into its constituents and look closely on every aspect of trust such that it can be inculcated through a virtual reality classroom environment. It is important to note that according to literature trust is a “psychological state” which establishes on need basis and changes with the external enabling factors. Research suggests that there are no concrete or tangible steps that can lead to trust building; however, there are certain underlying enablers to every environment, which can lead to it. A psychological state is a direct effect of emotional intelligence in case of trust and other empathetic states in students. The definition suggest furthermore that trust can be developed if the subjects feel comfortable and secure such that they feel less vulnerable towards the environment and there are no transactional costs to opening up in front of the audience. It is also important to note that expectations play a major role, and according to the literature, a student can trust the teacher only if there is an evidence that the teacher has positive intentions and the expected behavior is empathetic and kind towards the students.

In this study, we shall develop on these primary trust building factors, such that the virtual environment can act as a nurturing space for the underpinnings of establishing trust between teachers and students. It is furthermore evident that clear communication of intentions play a major role in such phenomenon; hence, it has to be made sure that the teacher is clear about her intentions at every point of the interaction and is constantly exuberating a sense of positive intent towards the students.

Conversely, in order to establish trusts among students it is important to take into consideration the emotional intelligence of the students such that the teacher can connect smoothly at emotional level and communication can be effectively drawn upon (Lewicki and Brinsfield, 2012). An essential constituent of a clear communication for building trust is effective management of feelings. In a classroom setting it is essential for both teacher and students to manage their feelings such that the intent is clear and messages are communicated smoothly. Hence, in order to build trust in a classroom considering emotional intelligence building factors is crucial. According to Bruno (2011) emotional intelligence can be explained as follows:

*“...managing feelings so that they are expressed appropriately and effectively, enabling people to work together smoothly toward their common goals.”*

Raider-Roth (2005) interprets that the most effective strategy to inculcate trust in a student-teacher relationship is through care offered by teachers towards the students. Care can take many different forms according to Leito and Waugh (2007), it is primary in the form of teacher caring for the academic progress of the student while at the same time it can take the form of teacher caring about the character building and elimination of fears in the students. In order to get beyond a superficial relationship, it is important for students to recognize their teacher and the system implemented in the institution to be authentic and genuinely driven for their wellbeing (Raider-Roth, 2005). According to research conducted by Cole (2012), the most important factor in establishing a strong and trustworthy relationship between teachers and their students is through care directed from teachers to students. This finding was well documented by the researcher as she came to the conclusion after conducting in classroom experiments and following up with interviews from both students and teachers. The researcher analyzed techniques in the literature in a real world modern classroom setting and then quantified the findings in the light of responses from the teachers and students. It is safe to assume that in order to establish trust the primary underlying factor is that of building mutual trust, such that students are free from intrinsic fears of opening up in a classroom and teachers can depend on students in maintaining an acceptable behavior (Cole, 2012). Both these aspects are comparatively difficult to realize in a virtual environment as compared to a traditional classroom setting. Nevertheless, the traditional theories and approaches can form the backbone of the strategy to be implemented in a virtual environment. Trust is established between teachers and students when both the parties feel that the environment is safe and protected to emotionally and rationally open up, and no unpredictable consequences may result in abrupt scenarios (Berrett et al., 2012). These two elements underlying trust shall form the baseline for the classroom environment in the SecondLife, which may enable trust and in turn enhance the level of learning and understanding.

One of the most essential underlying factor for establishing trust is that of inducing respect. According to researchers, respect can only be expected from students for the teachers if the teachers grant respect to their students in an earnest manner (Roberts et al., 2012). Researchers point out that student hence can instantly deduct any superficial attempts by teachers; it is proposed in the research that teachers whole-heartedly embrace this concept of respect being a two-way streak. Respect is important for eliciting trust mainly because through respect only students can be controlled in a professional manner while at the same time

students can be allowed to connect emotionally (Brookfield, 2015). Although one important thing to note is that building respect and ultimately trust is a passive process and is progressed gradually. Researchers suggest that any strategies which might promise building trust instantly might be phony from the get-go and shall be avoided. Instead, the best way to go at it is through consistent persistent effort from the teachers and environmental changes in a controlled monitored manner (Trust et al., 2016).

An important thing to note is the proposition of the environment in building respect and trust in students. This case scenario can be especially beneficial for a virtual classroom environment as teachers can conduct multiple changes in the environment as suited for their convenience (Hallam et al., 2015). Simultaneously, there are many disadvantages to VR classroom environments which may hinder the progression through sabotaging the monitoring process as students are not physical present and teachers cannot pick cues in their behaviors pointing towards their internal states (Boulos et al., 2007). The shall be directed at enabling mechanisms which may allow teachers to get appropriate and immediate feedback on student's behavior; although such emulations may be possible in the long run through biometric monitoring of the students but current there are limitations to such technologies (bailey and Bailenson, 2017).

Mendler (2001) propped a solution for enabling respect by proposing teachers to observe the students and connect with them at many different levels. Mendler (2001) proposed strategies for building strong relationships with students; the following excerpt from the researcher's conclusion is appropriate for consideration:

*"[establish] a caring environment in which educators know, respect and connect with kids. [...] There is no doubt that achievement is most apt to occur in a friendly, predictable classroom atmosphere guided by a [caring and] enthusiastic teacher who "connects" with students and encourages them to create, take risks, and share ideas"* (Mendler, 2001).

Literature provides evidence that if students are allowed to take controlled risks in the classroom environment they are prone to voicing their opinions more often that in turn establishes their trust. When teachers show concern towards student's opinions and try to address the problems, a sense of being valued is established which in return encourages the students to connect deeply. Such events allow for the establishment of safe and dependable classroom environment which is prerequisite of building trust and proceeds at accelerated student growth both academically and personally (Bruney, 2012).

### **Impact of teacher-student trust on academic achievement:**

Teachers' trust in their students can impact students' academic performance and students' classroom behaviors. In this section, researchers' investigations into the expression and impact of teachers' trust in their students will be explored. The impact that teachers' trust of students has on the learning environment, the influence that trust has on teachers' willingness to engage in constructivist teaching practices and the impact that trust has on teachers' choices regarding behavior management will be highlighted.

Finally, research regarding the impact of teacher trust on the parents of students will be briefly discussed. Trust can affect students' academic achievement and test scores in direct and indirect ways. When teachers create learning environments in which students feel comfortable, students will be more apt to interact with their peers in a positive manner and focus on learning (Ennis and McCauley, 2002). Students who perceive that their teachers like them, are fair, and have high expectations of them tend to show high levels of engagement, including paying attention, staying focused, and participating more in class. High levels of engagement in learning are associated with school attendance and higher test scores (Bruney, 2012). Schwarzer and Buchwald (2000) suggest that interpersonal trust can be a protective factor during an exam. Interpersonal trust may lead the student to exhibit more cooperative and pro-social behavior.

In their study of strategies used to reach disengaged and disruptive students by teachers in urban secondary schools, Ennis and McCauley (2002) found that the development of a trusting relationship between teachers and students is essential to creating an effective learning environment. Ennis and McCauley found that teachers demonstrate their trust in students in a wide variety of social and pedagogical ways. Teachers who trust their students are more willing to reconstruct traditional curriculum and use alternative strategies to address students' needs. Teachers "confirm their trust and care for students by permitting them to follow alternative curricular avenues while guiding them to expand effort and devote time to learning" (p. 161).

Researchers suggest that teachers and students influence each others perceptions and behaviors and that the use of a dyadic systems perspective on relationships is appropriate for the study of the teacher-student relationship (Brookfield, 2015). Students' classroom behaviors affect teachers' perceptions and classroom behaviors. Students' and teachers' behaviors in the classroom reinforce and confirm each others beliefs and expectations of the other (Schwarzer and Buchwald, 2000; Brookfield, 2015).

### 3.2 The emergence of virtual reality in learning

The current and prospective generation of learners are driven through the advanced use of technology in their everyday life. They are prone to the usage of internet and mobile devices from the get-go and can decipher messages delivered through virtual environment more promptly as compared to realistic communication [41]. Hence, institutions are facing difficulties in rendering their teaching procedures effectively to the so-called “Net Generation” through conventional means. Although institutions around the world has resorted to using online lectures for providing flexible access to educational content but such 2-D videos lack the ability to engage the students effectively and build trust for their educational and personal growth. VVs such as second life come with a promise of leap frogging such inconsistencies in delivering information such that maximum benefits can be achieved without teacher or student being physically present at the institutional facility [42]. Although the virtual platforms were initially established primarily for the purpose of collaboration in a game like environment but its acceptance at a wider scale and its ability of providing game like environment for enabling full trust makes it suitable for rendering teaching activities. The Multi-user Virtual World environments have gained tremendous traction in the last decade in the educational world mainly due to their suitability for rendering 3D modelling activities and co-manipulating opportunities that cannot be appropriately rendered through conventional social media platforms or through the use of online video content [42].

Vaughan et al. [43] investigated the relevance of virtual worlds in rendering educational activities through a metrics developed for students responsiveness and awareness when compared to other online platforms such as Facebook. The researcher found a notable degree of enhancement in student’s acceptance and trust of specialized content when delivered through VV environments as compared to social media platforms [44]. The main advantage of using VVs when compared with other formats of distance learning, is the ability of VVs to render complex interpretation of educational material in addition to just re-presentation of educational content in typing-based or oral formats [45]. The 3D VV allows for the co-creation of the educational content through rich trust from students and teachers alike which make it an active format of content delivery, unlike other formats which only allow for passive content delivery [46].

In this sense, it can be argued that if designed appropriately and used through proper techniques VVs can enable delivery of educational content in a much richer way even when compared to physical classroom environment [3]. However, there are a few limitations to using 3D VVs for educational content delivery, which shall be investigated in this research study and design decisions shall be

quantified to leapfrog such hurdles and enable the most effective educational content delivery. The VVs come with the inherent dynamic instructiveness of D graphics powered with multiple techniques of interaction which can be used to simulate virtual real life like scenarios without the use of any expensive equipment of requirement of space occupation [46]. Hence, 3D VVs offer a very cost effective way of allowing the students to observe real world complex phenomenon for practice purposes and without the use of any physical equipment. Furthermore, every student can be catered individually and the interpretation can be replicated on need basis. VVs such as Second life come with inherent tools which can be used for simulation and communication purposes such as verbal communication tools (text based brainstorming and VoIP), non-verbal communication tools (gestures and IM-messages), artifacts (objects such as avatars) and much more. These tools can be used in combinations to render micro-world workshops and real-life simulations without the use of any physical infrastructure [46].

The social VV platforms as the like of Second Life can integrate additional technologies to rectify the simulation process such as the 3D VR technology, communication channels (synchronous and asynchronous), a distributed user experience-using internet. Participant’s epagoge in the VVs as entities sharing a simulated space. Such VVs are commonly denoted in literature as the “multi-user” and “persistent” virtual environments; allowing manipulation, constructive and collaborative activities through multiple ways of communication [47], [3]. Such virtual infrastructure allows multiple opportunities for delivery of educational content such as diverse training programs in which students are actively involved in experimentation through collaboration. Collaboration is an essential feature of MUVW environment which makes it viable for educational growth as a shared sense of conscience is developed in a virtual world which motivates and encourages students to experience an active participation [48]. However, the main obstacle to overcome is such scenarios is establishment of trust in the classroom environment such that all the participants in a serious manner endorse the activities being offered and simulations conducted. If conducted appropriately the MUVW offer a comprehensive platform for the rendering of classroom environment with maximum student trust and accelerated growth in learning [46].

### 3.2 Trust in Virtual World (VV)

It has been well established in the literature that student trust can be elevated through collaborative teaching and learning processes such that a reinforcement can be carried out through peer interaction. In the recent trends in literature regarding teaching and learning techniques a new technique has emerged: Scaffolding process [49]. The



technique promulgates that the emotional state of the student play a vital role in the learning process [50]. According to Ismail et al. [51] student trust is an essential predictor of whether or not an educational material is helpful in learning. Hence, in order to ensure better learning in virtual environment it is important to implement techniques that may ensure full student trust.

Trust is the underlying factor which is a prerequisite to any learning process which ensures student trust [52]. Hence, factors denoting trust are an accurate of predictor of presence of trust among students. Similarly, Cavanagh et al. [53] have defined student trust in educational techniques as a tripartite framework, which includes the following:

- Behavioral factor

Focuses on student trust in the class in the form of their conduct during the activities.

- Emotional factor

Focuses on the attitude students show towards learning activities being rendered.

- Cognitive factor

Focuses on the level of self-regulation shown by students towards learning and goal setting. Student trust has been highlighted as the central axis of effectiveness in learning [3]. Regarding online and blended sessions being delivered in the past decades student trust has been shown as the most appropriate predictor of success of content delivery, which is further demonstrated to be enabled through a sense of trust in the classroom.

According to Jarmon et al. [47] Virtual world classroom environment can engage students through better connectivity, interactivity and resource access. Researchers have sided predominantly with higher levels of interactivity in VWs as an enabler of better student trust [51]. It is safe to assume that higher levels of interactivity is only possible if students have established adequate amount of trust in a virtual classroom environment. It is evident through literature that smoothness of communication and predictability of behaviors form the backbone of a student friendly environment that can nurture better interactivity.

Coffman and Klinger [54] argue that VW allow the teachers to use the tools for enhanced interactivity and student trust that are not possible in physical classrooms. Hence, the opportunities for better trust are greater in VWs as compared to physical classrooms. VWs offers tools that can inherently engage students through interactive activities with the teacher, the content and peers. According to Cruz-Benito et al. [55] VWs provide tools for community building through immersive activities, which offer better opportunities of trust as compared to face-to-face environments where students are hesitant to engage due to peer pressure or pressure of being judged by the instructor. Such experience motivates and encourages students to

engage more often in collaborative activities and exploit the educational content on self-regulated basis [56]. A constructionist leaning approach gives courage to students and motivates them to adopt quickly and involve more often with the challenging tasks at hand to feel a sense of achievement in the community. Such environments give students a chance to leapfrog the emotional and behavioral limitations imposed on them due to their complexes or underdeveloped abilities [57].

Trindade et al. [58] noted that VWs provide better opportunities for the learning of higher levels skills which involve practical implementations of conceptual framework. The researchers conducted experiments using control groups, their results demonstrated that VWs could enable better trust in tasks related to development of higher-level skills as compared to physical laboratories. The researchers further demonstrated that VWs with better trust techniques and trust enabling mechanisms can result in a better outcome of learning in case of higher level skills.

Shear and Penuel [59] noted that student trust in virtual world may be enhanced through the use of problem based situations in which students are allowed to exploit multiple possibilities to reach a set goal, constructing a game like scenarios. The researchers further demonstrated that such immersive techniques results in better student to student as well as student to teacher interactivity causing a sense of cohesion among the whole class and developing trust as more activities are conducted along the way [60]. Hence, according to these findings in order to ensure better trust and trust among students the teaching material should be based on problem based tasks in which the knowledge offered in the class is utilized in a meaningful way through collaboration to solve simulated scenarios.

### 3.3 Second Life in Education

According to Esteves et al. [61] Second Life has proved over the years as a dependable and effective platform for rendering of 3D interactive educational content allowing the simulation of collaborative-constructionist activities. Literature provides many examples of the use of SL in higher education as a candidate learning platform ([62]; [63]).

Among the virtual world platform available in the market, educational researchers have almost unanimously declared Second Life as the most mature and reliable platform with all the essential tools, which enable flexible designs [64]. Usage statistics demonstrate a similar story in which most of the educational institutions have chosen Second Life for their virtual educational services. These findings can be extrapolated from the survey conducted in UK: Eduserv Virtual Worlds. The survey focused on the educational use of virtual worlds in tertiary educators [65]. The results clearly demonstrated an outlier in terms of its usage intensity as the Second Life and follow-up interviews

confirmed the findings. It was found that educators in the tertiary sector rely primarily on SL as a resource when designing any 3D virtual educational activity [66]. The following findings from the aforementioned survey provide the evidence of the higher degree of usage of SL:

*“Taking into account institutions who haven’t responded but where there is reasonable evidence of SL activity, and institutions who are developing in SL but not in a public way, then a figure of roughly three quarters of UK universities are estimated to be actively developing or using Second Life.” [67].*

Furthermore, it is evident from recent surveys conducted globally in educational institutions that the usage of Second Life for educational activities and services is on the rise [68]. The survey conducted in UK in 2008 showed a substantial increase in the usage as compared to the figure reported in 2007, where only 40 universities in UK were present on the SL grid [67]. According to the reported data the following were the main reasons which encouraged educators to vouch for Second Life predominantly while other feasible options such as OpenSim were discarded:

- Low cost to entry
- Ability to create complex objects
- Ability to create complex environments
- Sophistication of graphics, giving a real world feel
- Ability to construct immersive experiences

Educators identified many other advantages of using Second life for educational purposes; however, the abovementioned reasons were identified unanimously, which give the platform an edge over its competitors [67]. It can be extrapolated from the identified advantages that Second Life has all the tools and elements required to inculcate trust-building measures into the classroom environment that are identified in the previous sections. Hence, for the current study Second Life is the most appropriate platform for implementation of designs and deciphering the ability of virtual worlds to nurture trust in classroom among the students [68]. Such trust in return enhances the willingness of students to learn and increases their ability to experience the content collaboratively. The following Table 1 provides an overview of the notable application of SL in higher education, divided under format category:

**Table 1** Evaluation of SLin higher education

| Category                               | Use of SL Overview                                                                                             | Study Reference                                                                                                                                                                               |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Constructionist</b>                 | Use of constructionist setting for innovative learning processes                                               | Kao and Harrell, 2017<br>Good et al., 2008<br>Girvan et al., 2013<br>Good et al. (2008);<br>Luo et al. (2008);<br>Jarmon et al. (2008);<br>McKay et al. (2008)                                |
| <b>Collaborative</b>                   | Evaluation and designing of collaborative activities                                                           | Vrellis et al. 2010<br>Morch et al., 2017<br>Brown et al. (2008);<br>Hobbs et al. (2006);<br>Mayrath et al. (2007)<br>Gillen (2009);<br>Rycroft (2007)                                        |
| <b>Interactive</b>                     | Evaluation of learning outcome using a metrics based on social interaction with multiple users                 | Mercer e al., 2017<br>Zhang et al., 2013<br>Dickey, 2010<br>Wang and Burton, 2012<br>Gao et al. (2008);<br>Mayrath et al. (2008);                                                             |
| <b>Distance learning</b>               | Implementation of environmental studies course over internet through the use of psycho-sociological techniques | Hartley et al., 2015<br>Omar et al., 2018<br>Wang et al., 2011<br>Turkay and Tirthali, 2010<br>Pillas and Kazanadis, 2013<br>Brown et al. (2008);<br>Chow et al. (2007);<br>Luo et al. (2008) |
| <b>Interactive game-based learning</b> | Using interactive game-based learning for a progressive learning interaction                                   | Le et al., 2016<br>Jong, 2015<br>Lan et al., 2018<br>Terzidou et al., 2012                                                                                                                    |
| <b>Professional development</b>        | Providing teachers with options as an alternative way of professional development                              | Vasileiou, and Paraskeva 2010<br>Gillen (2009);<br>Pellas, and Kazanidis(2015)                                                                                                                |
| <b>Course delivery</b>                 | Delivering educational content related to information science                                                  | August et al., 2016<br>Elis et al., 2018                                                                                                                                                      |
| <b>Blended courses</b>                 | As a support mechanism for online course delivery as a blended approach for tourism and hospitality            | Pellas, N., & Peroutseas, E. (2017)<br>Kostarikas et al., 2016                                                                                                                                |

### 3.4 The Way Forward

A thorough review of literature clearly demonstrates that although multiple studies have been conducted to analyze trust in a virtual classroom but in all of those studies the theoretical constructs of trust in classroom and its impact on learning is restricted to that of traditional classrooms. However, in the current research it is analyzed that multiple case scenarios that are based on the

technicalities of a virtual environment can influence trust in a virtual classroom.

Hence, it can be proclaimed that a comprehensive study related to analysis of trust in an SL classroom is nonexistent. The current study is designed to fill the identified gap in the literature and, based on the needs and requirements of the SL and teaching community, design processes through which trust can be inculcated and maintained in an SL environment.

Through the review of the recommendations provided by the researchers in the literature regarding good practices while using SecondLife for classroom some common themes were identified which can play a role in enabling trust as well. A prominent theme was that educators should establish a clear connection between course objectives and course activities in Second Life [83] and that a correspondence between the technology and what students view as being useful to them must be present to hold their attention [91]. Without this connection, students may not see the value or relevance in using a tool such as Second Life ([91]; [47]; [6]). A second theme was that educators should place an emphasis on technical training and support, as Second Life requires robust, up-to-date computers to handle and run the software, and support staff who are familiar with Second Life were not available ([70]; [83]; [47]). A third theme was that educators should provide scaffolding activities inside Second Life which help students to build skills, to practice, and to acclimate to the virtual environment ([12]; [83]). [17, 66] mentioned a fourth theme that spaces, such as collaborative zones and lecture rooms, should be constructed to achieve or encourage intended instructional goals and objectives. Hence, in the current study a unique methodology is adopted in which literature related to traditional classroom and teaching techniques has been studied deeply to filter the essential trust building techniques. In addition, three different trust-building layers are identified and analyzed based on their impact on trust. Consequently, a detailed study carried out on the potentials of Second Life gives a technical standpoint which will allow the researcher to incorporate all the identified theoretical underpinnings of trust in students. Hence, the designed system shall be realistically in accordance with the findings from the literature, surveys, interviews and case study, ensuring that the most essential trust building features shall be incorporated in the Second Life classroom.

#### 4. Methodology

Figure 1 demonstrates a process of analysis of requirements using different approaches to data collection. The aim is to conduct triangulation of findings and transform them into the technical requirements for the developed Second Life classroom, to ensure that the

practical implementation is backed by theoretical and experimental underpinnings. Hence, in this way the research encapsulates all the essential elements for building trust in students when operating in VW environments.

Given the fact that many universities have deployed and offered innovative different course delivery methods with both blended and online instructional formats through SL ([69]); however the respective added value or otherwise the effectiveness of these methods on students' trust are largely unknown. An emerging research hypothesis that can be raised was if it could be any significant differences on students' trust through the blended or online university-level courses by utilizing SL. Seemingly, this study seeks to measure the growth-promoting factors (emotional, behavioral and cognitive) that may affect student trust in blended and online courses, which to date have not been examined yet.

The present study seeks to fill the void that depicted from the literature review and it presents the results of the students' trust through an empirical comparison of collaborative activity that was implemented in Computer Science course different instructional formats (blended and online) held in SL. The expected contribution should be proceed from the results and can become an important guidance for other future driven learning directions which can utilize SL for educational purposes in different formats concerning the following:

1. The potentially best learning outcomes which can be provided some additional instructional affordances that may assist students to participate and learn with others in a common 3D visually-rich environment
2. The highlighting issues relating to the physical (or not) users' presence in a common virtual environment, and how this learning evolution with its results (i.e. the acquisition of knowledge) can affect learning outcomes,
3. Significant usability issues about the communication tools that facilitate: (i) the learning process and how innovative media resources in a 3D VW can be coped according to students demands or needs and (ii) enhance the quality of cooperation and satisfaction between users from it at a more agreeable climate which is different from traditionally defined.

The study shall use the proposed and tested components of instructions in a classroom in traditional as well as online methods and then design a classroom in SL based on implementing all those components in a virtual environment. The rationale should be to test the technical underpinnings of SL to implement all the components of enabling trust. The through a short survey all the designed components of trust are validated from the students.

A recurrent theme in much of the existing literature is the call for further research to consider, firstly the unique properties of SL and other virtual worlds as a teaching and learning tool, and consequently the effectiveness of the use

of SL in terms of adding value to learning outcomes for the students in that regard for better problem solving GloVED model is utilized (given in figure 2). The research methodologies utilized to date are criticized for lacking a solid grounding in contemporary learning theory and for their shortcomings in terms of academic rigor (Salmon & Hawkrige 2009; DeFrias 2008; Jacobsen et al 2008).

#### 4.1 Research Approach

The main approach chosen for the research is inductive in nature; however, in the second phase of study a deductive approach is also utilized. The overall approach for the research is qualitative as trust in students is an abstract construct and using black box approach is not appropriate in this context. In the first phase of the study, data is collected in different forms both secondary and primary with a focus on extrapolation of important design concept which may enable trust in the proposed design for the SL classroom. Hence, throughout this process an inductive approach is utilized as through content analysis techniques the underlying factors and techniques enabling trust for VW classroom are extracted. The findings induced from the conducted research are then integrated through triangulation.

Other than basic techniques of literature review a case study approach is also used to explore deeply the Secondlife classrooms and the impact of design features on the teaching effectiveness. Case study research is a qualitative approach in which the investigator explores a real-life, contemporary bounded system (a case) over time, through detailed, in-depth data collection [93].

Stake [94] purports that qualitative researchers seek to understand a case –to appreciate the uniqueness and complexity of it, its embeddedness and interaction with its contexts (p. 16). Stake contends that the real business of case study is particularization, not generalization -- we take a particular case and come to know it well. He says qualitative study capitalizes on “ordinary ways of making sense” (p. 72). According to Stake, cases seldom exist alone, if there are phenomena in one, there are probably more somewhere else. Creswell [93] says “often the distinction between qualitative and quantitative research is framed in terms of using words (qualitative) rather than numbers (quantitative)” (p. 3). That being the case, my use of the qualitative research method to determine a teacher’s affective acumen as opposed to evaluating her by her students’ test scores would seem like a ‘best fit’.

Building from the collected data and the design characteristics of the proposed system, a prototype is then implemented in Secondlife. A set of hypothesis for the study are utilized in this stage that are acquired through the prior stage of inductive reasoning. Through deductive approach, the prototype implemented is then evaluated. Interviews with experts are designed for the study in order to validate the findings of the literature review. Another

important aim of the interview is to find essential behavioral characteristics of the students through experienced individuals and learn from the strategies for building trust that work at the grass root levels. “Finding interviewees with the relevant, first-hand experience is critical in making your results convincing” (Rubin & Rubin, 2005, p. 68). Rubin & Rubin propose that, in order to be able to build a theory that has broader implications, a researcher should select interviewees that assure confidence in extending findings beyond the immediate research setting.

#### 4.2 Research Limitation and Concerns

The first and foremost limitation to the research is that it is aimed at analyzing an abstract construct of student behavior, which has no quantitative denominators. Trust in students, as analyzed in the literature, develops through a slow moving process and the effects the VW classroom environment executes is passive and long-term.

Furthermore, the study is focused on a technology, Secondlife, which may change in the future. It is well established that the past decade has experienced an unprecedented change in technology. As there is better hardware with lower cost becoming available for virtual reality technology, the total outlook towards VW environment is under a flux. A main theme accessed in the literature is that of an integration of virtual and real worlds where augmented reality based technology is on the rise. The sample size of the research is limited due to the time and scope of the study conducted. Given that it is extrapolated from the literature that short term experience of the classroom environment in SecondLife may not replicate into effective insights, hence, the approach taken for testing the design characteristics and their effectiveness is not aligned with the traditional method of early prototyping in the community.

Deyhle et al. [12] argue, “Research in education, whether quantitative or qualitative, is basically applied research. The results of such research almost always have immediate or potential practical applications or implications” ([12] p.610). While many qualitative researchers ([13]; [14]; [12]) understand that there are no set ‘ethical rules’ in place for qualitative researchers to follow, best practice dictates that mindful and reflective strategies should be at the forefront of the study design. To that end, my interaction with this study participant included opportunities for questions, clarification of process, and assurance of confidentiality.

In order to reduce the side effects the chosen experimentation process is that of waterfall model instead of early prototyping. As the designed classroom already inhabits the essential elements of good learning and teacher-student relationship, any negative effects are eliminated from the get go.

## 5. The SL community report analysis

In order to extrapolate the recent trends in educational services provided by educators on Second Life, a content analysis approach is used to scrap through all the posts related to educational experiences published on the official website for the Second Life community. The main tool used for this approach is NVIVO, which shall allow making important inferences from huge chunks of unstructured data collected. This is a very effective approach to understand the trends in technology as it allows for understanding of latest ideas and techniques implemented worldwide. Using NVIVO various queries shall be conducted on the content collected mainly related to trust building and engagement in Second Life Classroom. Different topics for the threads are considered which match closely to the aims of the current study. The main aim here is to analyze the experiences of the educators when delivering lectures in a classroom designed in SL. Trust building factors and their relevant impact shall be filtered through queries conducted in NVIVO. The community portal used for the analysis is the official portal designed by the SecondLife team of developers and is actively visited by professionals from all over the world. Hence, the community portal houses all the important and up to date insights and techniques acquired by SL educators from all over the world.

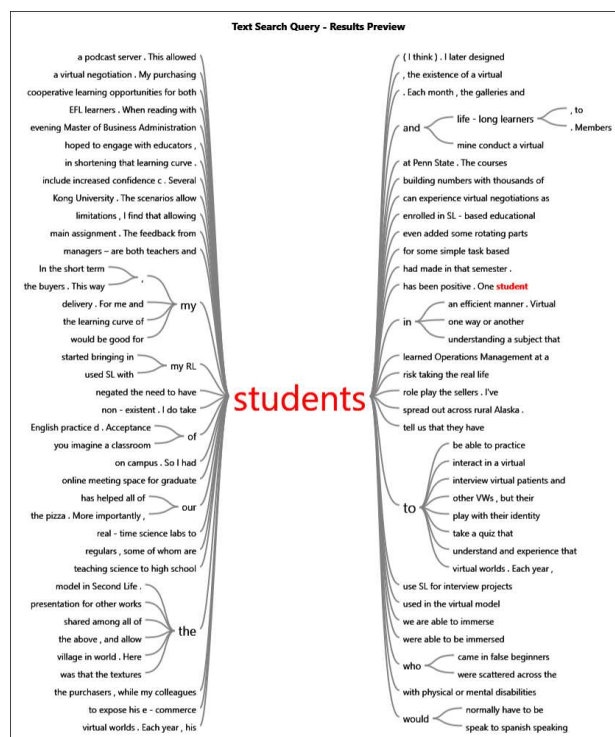
### Topic 1: Educational experience success stories

Xiola Linden who is a Lead Community manager and is a credible source given her vast experience in posting essential information for the community posted the topic. Linden has a “Member’s Total Reputation” (metric developed by Second Life team to measure the contribution from a member) of 417, which is quite high as compared to other community managers. Hence, it can be concluded that the posts under the topic are mainly from authentic educators. The topic stresses on three questions to be answered:

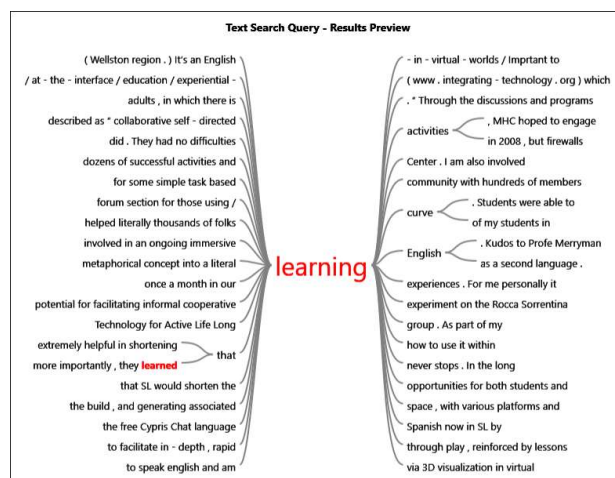
*“What educational organization do you represent?*

*How do you use SL in your educational endeavors?*

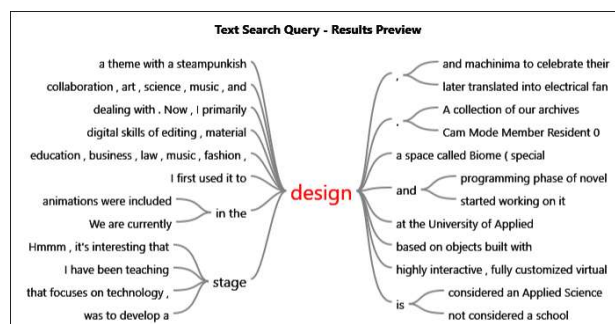
*Most importantly, what positive results have you seen from using SL?”*



Query 1: Students



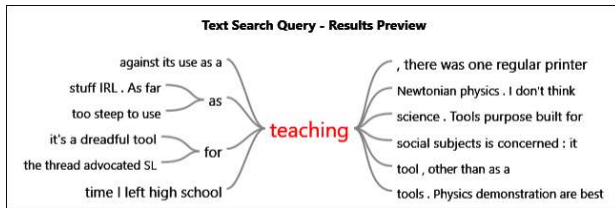
Query 2: Learning



### Query 3: Design

#### Topic 2: Using SL for educational purposes

This topic was posted in February 2019 by Bree Giffen. Bree Giffen has an outstanding “Member’s total reputation” points, that is 995. Hence, the topic comes from an authentic source and is responded by many senior educators. The posts on the topic provide insights into the current trends of techniques being employed by educators in SL.



### Query 1: Teaching

## 6. Survey and Interview

### 6.1 Survey introduction and demographics

This survey is conducted to extract first-hand information from the students and teacher in order to construct the possible ways in which trust can be established in an SL classroom. The survey includes questions related to the experience of the students and teachers with SL; in addition, takes their opinion on the possible mechanisms and tools, which may be able to establish better classroom experience in SL. Given that, general population does not have vast experience in SL learning and teaching, hence, for the purpose of the survey the targeted audience is that of the SL community members that are selected based on their contribution to the community and their prior experience with SL. In order to make sure that the responses gathered can essentially contribute to the study the participants are handpicked by the researcher after analyzing the discussion forums and contribution of the community members.

The survey questionnaire is designed after acquiring information from the literature review as well as case studies, in order to highlight the relevant issues related to trust and their possible solutions in SL classroom. Furthermore, the survey encourages participants to offer their solutions for the identified problems and allows them to provide technical knowledge for the incorporation of tools based on their individual experience.

In total around 50 community members were selected for the survey. The survey was sent to them in the form of private message with a cover letter explaining clearly the intents of the survey and the orientation of the study being conducted. On the request of multiple community member sand in compliance with the regulations of the community, the private information such

as the email and contact details was not inquired in the survey and responses were received anonymously.

A total of 38 responses were received which were then analyzed for outliers and bogus responses through a manual analysis. At the end, a total number of 36 responses were included in the statistical analysis, which formed the basis for the decision-making and requirements of the prototype. The survey was conducted through an online platform survey monkey. The participants were first informed cordially to take the survey and they were provided with some peripheral details about the scope of the study. The participants were mainly the members of the learning and teaching community in the larger SL community online portal.

The data acquired through the responses was then analyzed in multiple ways to extrapolate trends in responses. Data analysis was carried out using SPSS, which also allowed the research to visually interpret the results and explain them for better utilization. The questions asked from the participants in the survey are mainly associated with their experience in using SL as a tool for teaching and learning. It is established through an informal discussion with the members of the SL community that trust in an SL classroom is an abstract concept, which is not well established theoretically among the community. Hence, the design of the survey is in such a way that initial questions allow the participants to delve upon their experience to truly understand the importance of trust. Moving forward they are asked about the implications of trust in an SL classroom and they are encouraged to share their opinion in a semi structured manner to illustrate their personal leanings.

Given that trust has been established in multiple layers for the classroom by the virtue of this study, solutions and suggestions are inquired from the participants based on each of the identified layer. The survey also contains some technical questions such that participants can share their ingenious ideas related to the technical details, such as the enhanced usage of smartbots and the possible ways in which they can be monitored. Furthermore, participants are inquired regarding hypothetical scenarios as to what their preferred design choices may be for a defined trust related problem in an SL classroom.

In the above stated manner, this survey acts as an illustration of the most applicable and cutting edge techniques that are being currently rendered in the community. The data acquired is unique and creates value for the teaching community as no such survey has been carried out indicating the theoretical underpinnings, implications, and solutions related to trust in SL classroom.

### 6.2 Survey Results

The results of the survey demonstrate that there is a fair division of domains of respondents which provides a better view regarding SL as a teaching platform. The results



further demonstrate that SL is regarded as an industry leader and is an appropriate platform for conducting teaching and learning activities. This is demonstrated by the result of the second question in which majority of the respondents selected “A great Deal” in response (about 385), which was followed by “A lot” standing at 32%. The results demonstrate that the respondents consider SL as a lucrative platform and are in favor of using it. Hence, the responses to the following question provide a better insight into its issues related to trust.

The trust of student-teacher in second life is also considered by most of the respondents to be very important; an important thing to consider in this result is that above 10% of the respondents believe that the student teacher trust is not at all important when conducting teaching activities in SL.

An important outcome from the survey is the information regarding design features for the proposed classroom. In that, regard question 4 is designed to understand the relative importance of bottlenecks experienced by the respondents. Such an approach provide with a first hand experience with the latest updates in Secondlife. The highest in terms of importance is the lack of availability of behavior monitoring mechanisms in the classrooms. This is one of the reason that the second layer targeted for the current prototype is that of behavioral layer. At second position comes the ability of students to trick their presence in the classroom. Another important issue which was selected by great amount of respondents was that relating to inefficient teaching strategies. All the rest of the issues are also considered in the requirements phases of the project.

Moving on one of the most important questions in the survey was about the trust conceptualization in the context of a virtual classroom. A great majority of the respondents almost all of them selected the option related to the monitoring of behavior in the classroom. Which is followed by the trust of teacher on the mental presence of the students. At third number comes the trust in the environment such that the students do not face technical issues.

The sixth question is a little different from the previous ones as it requires the respondents to give their opinion on the tools that can be utilized in different domains of trust. This question provided a great insight into the techniques that can be utilized for the current project. The question was responded by around 30% of the respondents and the results of the responses are demonstrated in the tabular form. The responses were then analyzed for the next chapter in which the requirements of the classroom in SL were used to define the tools to be used in SL for trust enabling factors.

Furthermore, the participants were required to select from a list of techniques for authentication, which provided a greater insight into what re the most appropriate techniques

currently being deployed. According to the results a great majority chose the use of voice recognition through the use of microphones and the use of during lecture quizzes to check if the students were present themselves. These two solutions formed the basis for the design features for the authentication layer in the deployed project.

Finally, two important questions were asked to get an overview of the way trust is recognized by the respondents. According to the selection of respondents the correlation of trust to learning is around 70%, which shows that they believe that trust plays a major role in enhancing learning in a virtual classroom. The second question is related to the ways in which trust can be measured, which was selected to the number of times trust-damaging scenarios occurred during lectures.

The following figures provide exploratory results as a highlight of main questions:

| ANSWER CHOICES                                                             | RESPONSES |
|----------------------------------------------------------------------------|-----------|
| Classroom environment is not conducive to learning                         | 56.25%    |
| The teachers are incapable of effectively delivering the content           | 43.75%    |
| The classroom designs are not appropriate                                  | 43.75%    |
| There is a lack of active and passive monitoring for behavior control      | 87.50%    |
| The teaching strategies used by teachers are not effective                 | 68.75%    |
| The students are unable to trust the teaching environment                  | 37.50%    |
| The students tend to use fictitious means for tricking their participation | 81.25%    |
| The platform of SL is not user friendly                                    | 43.75%    |

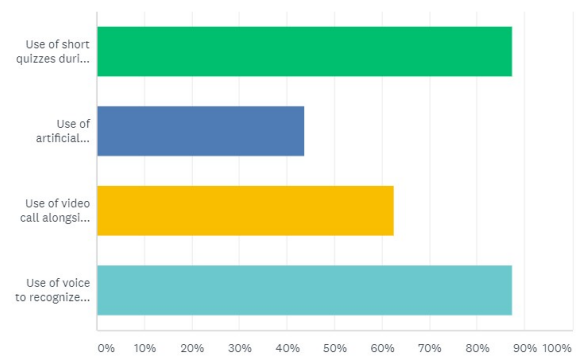
**Table 2:** Responses to Question 4: *According to your prior experiences or information related to SL classroom, what kind of bottlenecks exist in maximizing learning potential through effective teaching? (select as many you deem appropriate)*

| Respondent Number | Student avatar authentication                             | Behavior monitoring in classroom       | Classroom design features    | Teaching strategies                            |
|-------------------|-----------------------------------------------------------|----------------------------------------|------------------------------|------------------------------------------------|
| 4                 | voice attendance                                          | strict measures and deduction of marks | use of objects to show rules | evidence based                                 |
| 6                 | checking counter for students to move to and authenticate | support team                           | use of objects to show rules | Moodle utilization                             |
| 7                 | use of voice                                              |                                        | minimalist designs           | engagement in material                         |
| 13                | group discussions mediated by teachers                    | through a teaching assistant           | minimalist designs           | using engaging content and case-based learning |
| 14                | voice attendance                                          | strict measures                        | minimalist designs           | evidence based                                 |

|    |                                                           |                                        |                                    |                                                |
|----|-----------------------------------------------------------|----------------------------------------|------------------------------------|------------------------------------------------|
|    |                                                           | and deduction of marks                 |                                    |                                                |
| 17 | use of voice                                              | smartbots                              | use of objects to show rules       | Moodle utilization                             |
| 19 | use of voice                                              | smartbots                              | simple                             | evidence based                                 |
| 24 | checking counter for students to move to and authenticate | support team                           | simple and spacious                | engaging                                       |
| 27 | use of voice                                              | smartbots                              | simple                             | engagement in material                         |
| 30 | use of voice                                              |                                        | easily and clearly visible content | Team teaching                                  |
| 31 | group participation                                       |                                        | simple                             | evidence based                                 |
| 34 | voice attendance                                          | smartbots                              | use of blackboard with rules       | engagement in material                         |
| 36 | group discussions mediated by teachers                    |                                        | minimalist designs                 | case-based learning                            |
| 37 | voice attendance                                          | classroom support team                 | using actual classrooms as a model | using engaging content and case-based learning |
|    | pattern recognition                                       |                                        | use of objects to show rules       | Moodle utilization                             |
| 41 | voice attendance                                          |                                        |                                    | evidence based                                 |
| 43 | checking counter for students to move to and authenticate | smartbots                              |                                    | Moodle utilization                             |
| 47 | use of voice                                              | strict measures and deduction of marks |                                    | engagement in material                         |
| 48 | group discussions mediated by teachers                    | support team                           | use of objects to show rules       | using engaging content and case-based learning |
| 50 | voice attendance                                          | classroom support team                 | use of objects to show rules       | evidence based                                 |

|    |                                                           |                                        |                              |                        |
|----|-----------------------------------------------------------|----------------------------------------|------------------------------|------------------------|
| 53 | use of voice                                              | through a teaching assistant           | minimalist designs           | Moodle utilization     |
| 56 | use of voice                                              | strict measures and deduction of marks | minimalist designs           | evidence based         |
| 57 | checking counter for students to move to and authenticate | smartbots                              | minimalist designs           | engaging               |
| 59 | use of voice                                              | smartbots                              | use of objects to show rules | engagement in material |

**Table 3:** Responses to question 6: . *What kind of features or tools in SL do you find important in enhancing the following domains of trust? (fill in the answer box according to your knowledge)*



Responses to question 7: *Kindly select most appropriate techniques for student avatar authentication*

### 6.3 Interview

For the purpose of this study, interviews were carried out online, using skype as a medium. The targeted individuals for the interview were selected on the basis of their experience and expertise in SL teaching and classroom management. The main aim was to get a first hand view of how the cutting edge techniques in SL are being utilized by teachers which might give some insight into the trust inducing mechanisms. The experts were found using the SL teaching community, based on the experience shared by them on forums related to their experiences. Once the individuals were selected they were approached through private messages on the forum. In accordance with their response and availability a cordial invitation was sent for confirmation. In total three individuals were approached for the interview, out of which two responded to the request and only one was available in the set timeframe for the interview

which was designed to be carried out in an hour. According to the requirements of the expert being interviewed their personal information was kept confidential.

The questions followed a flow in which the interviewee was first requested to introduce himself or herself, this was followed with a request to share their major experience and highlight the projects they have undertaken in SL teaching. Then they were prompted to give an overview of the SL platform as a teaching tool as well as point towards the value it has the potential to create for the learners around the world. Given that, the main aim of the current study is to understand the role of trust in an SL classroom, considering it is not a very well documented and concrete concept, the interviewee was prompted with some questions, which could allow them to brainstorm the idea according to their knowledge. Once the interviewee was introduced the main theme of the study, they were then requested to highlight main bottlenecks faced by them during their experience as a teacher in SL. Then they were asked to highlight the role trust can play in establishing better relationship between students and teachers.

Following the questions related to trust the direction of the interview was shifted towards discussing the technical infrastructure of SL and the tools interviewee has utilized during their past projects. Here question related to their design choices were asked and an overview of the results on learning and the response of the students was analyzed. Then the focus was shifted to using the techniques in SL for inducing trust and making the classroom environment conducive to trust building. A few questions were asked related to the role of smartbots in SL classroom. Through the interview, a very novel approach was idealized for all of the three layers, which seems simple yet profound and solves all the issues related to trust damaging scenarios. Furthermore, the views of the interviewee were taken on the role of artificial intelligence in SL and how it can be utilized for the current scenarios.

The interview was conducted with an advisor in SL community. The community name of the interviewee is Lindal Kidd, and has an extensive amount of experience in SL education. In addition the reputation of Lindal Kidd is excellent, which translates to the authenticity of the information she shares with her peers.

The actual name of the interviewee is Mr. Joff Chafer. He is a teacher at the School of Art and Design at the Coventry University, UK. He is an expert in creating second life experiences for students and teaches a course for students across university for using second life as a creative instrument. This provides him the unique experience in both teaching in secondlife and as well as teaching second life as a tool.

Detailed Interview scripts may be provided on demand.

## 7. Case Studies

This section provides important insights from experiments conducted previously and we will contact the researchers to gain secondary data relating to the element of trust experienced in their point of view in the Virtual environment. This shall allow us to generate a list of points, which ensure trust in SL learning environment.

Three different case studies are analyzed to dig deep into the findings from the actual implementations in the past. An inductive approach is utilized here where the results reported by the researchers are used for the validation and enhancement of the data already collected for design constituents. Yin (2009) writes that the case study's unique strength is its ability to deal with a full variety of evidence sources such as documents, artifacts, interviews, and observations – beyond what might be available in other types of qualitative methods. He declares that use of the case study strategy has a distinct advantage when a 'how' or 'why' question is being investigated about a contemporary event over which the investigator has little or no control. The case study method allows investigators to retain the holistic and meaningful characteristics of real-life events (Yin, 2009). Yin writes that "case study research involves study in a real life context or setting" (p. 9).

### Case Study 1: SL for digital Games Education

The figure below demonstrates an overview of the system being analyzed for this case study. The aim through the analysis of the system is to extrapolate important findings related to designs of the classroom, the conduct of teachers and its effect on student trust and engagement. The findings acquired through this case study shall be used for the design requirements of the SL classroom proposed for ensuring trust in students. The main reason for selection of the system as a case study is because of its state of the art usage of technology such as Head Mounted Display, which allows for the submerging of real and virtual worlds. Furthermore, some important design considerations have been taken in this system to ensure better student-teacher relationships that can be instrumental for the current research.

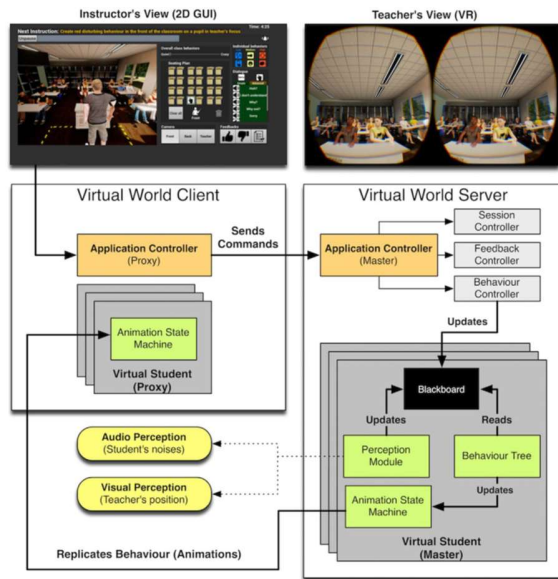


Figure 9 System overview of breaking bad (Lugrin et al., 2016).

## 7. Prototype Design and Requirements

The literature review, content analysis and case study approach taken for data collection provide clear evidence that there is a lack of comprehensive study identifying the impact of trust in virtual classroom let alone in SL. It is identified that in a virtual classroom trust can be influenced at multiple stages. Some studies indicate the impact of trust based on theory of traditional teaching in virtual environment, as well as a very few studies have analyzed the impact of trust based on student behavior within an SL classroom but almost none of the studies considered different trust influencing factors in parallel. One of the dimensions of trust is almost never analyzed in the literature which is based on authentication and identification of students as represented by their avatar. Hence, in this study a comprehensive framework of trust is established based on case scenarios. After a thorough analysis of literature and data collection from multiple platforms, it is evident that in order to construct an SL classroom in which the impact of trust can be fully materialized there are three basic layers of trust that are to be constructed:

- Authentication and identification layer
- Behavioral layer
- Teaching strategy layer

For each layer multiple tools are to be utilized for full capabilities of techniques to be implemented. The design of the prototype is constructed keeping in close consideration the techniques to be used in all three layers both technical and strategic. Hence, the design of the prototype is divided in three separate parts in which the first part focuses on

implementing techniques for the authentication layer; the second part focuses on the behavioral layer; and the third part is based on teaching strategy layer.

For each trust-establishing layer, multiple trust damaging scenarios are identified in the light of the data collected in the previous chapters, which are then converted, into the functional requirements for the implementation in SL. These functional requirements provide the basis for the prototype that is then constructed.

In this study, an out of the box thinking approach is used to solve complex problems associated with SL classroom. IN addition to highly technical and complex approaches for solving problems, two very intuitive approaches are proposed; Although these approaches are simple but they have the potential of solving all identified trust related issues. It has been noticed that such solutions have not been proposed in the literature, although such techniques are frequently used in brick and mortar classrooms. Firstly, using small, intuitive quizzes randomly asked during the lectures, to differentiate smartbots from students. Such quizzes may be conducted in alternative out-of-world forums such as course management systems. Secondly, the use of a teaching assistance expert in SL usability, who shall enforce class conduct rules without disrupting the momentum of the lecture being delivered (this approach is also very useful to solve technical queries of students related to the usage of SL as a technology, which according to the literature is an essential component of teaching in VWs).

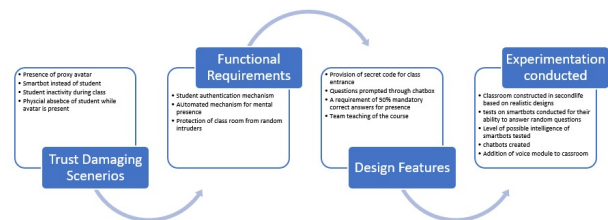


Fig.10. Requirement Layers in SL

Process flow for the defined 3 requirement layers. The summary of requirement model defined from this research is given in table 1.

## 8. Experiment and Evaluation of classroom in SL

The experimentation is conducted in SL using the requirements identified in Table 1. The identified design features as well as tools and techniques based on requirements are also implemented on the classroom. The

Figure 4 provides a glimpse of the experiments being conducted in SL classroom constructed for the purpose of this study under the username: Awatif2016

The teacher stands over the rectangular gray area and the students avatars are sitting on the chairs. The student avatars are given an attire of usual students in the KAU classrooms. The picture at the back is that of a Sloodle board which provides information to the students through smartbots. Smartbots also analyze the behavior of students using the protocols established in the previous chapter. For authentication layers multiple security checks were used for each avatar such that the identity can be fully checked and established as it is one of the most important factor in establishing trust analyzed from literature. Figure 5 demonstrates the flow diagram for the authentication and security layer of the classroom in SL.

## 8.1 Discussion

Technology assisted learning tools and technologies have been in use for the last few decades. These technologies enhance the user experience and help in the delivery of learning contents more effectively. It has been established by various research studies that technology assisted learning is more effective than the traditional classroom teaching environment. With the introduction of state of the art 3D virtual environments such as Second Life, this has added another dimension to the technology assisted learning experience.

A study was carried out to investigate the user experience of the Second Life learning environment and compare some of the basic elements such as usability, ability, interaction, simulated behavior, environmental safety, understandability and overall user satisfaction. The total sample size for the study was six trainee teachers with six observers; however, the availability of users experienced in teaching in the Second Life teaching environment was challenging. Analysis of responses suggests that responders had a good understanding of the problem domain.

In response to the question asked regarding the safety of the Second Life teaching environment, over 80% of the respondents said they felt safe in the virtual learning environment. Only 16% of the respondents gave a neutral response. In response to a question regarding the control of the avatar, 100% of the respondents either agreed or strongly agreed with the statement that they could control their avatar easily. In response to this question, it can be concluded that users found it easy to control their avatars. The traditional learning environment in rare conditions becomes inaccessible, which may affect the learning process, whereas SL, being a virtual environment, provides a safe learning environment.

Questioning the ease of use of the technology, respondents were asked if they felt that the technology

was difficult or awkward to use. Over 80% disagree with that statement. This establishes the fact that the Second Life virtual world-teaching environment is easy to use. Another question addressing the ease of use of technology asked if the respondents found it easy to construct a basic learning environment within Second Life; 100% agreed with the statement. This again reaffirms that the technology is user-friendly. In response to a question asking users if it was easy to locate the controls to activate the lecture, however, the overall response to the question was neutral. In another question addressing the ease of use of technology, it was asked if respondents found communicating with the smartbot to be quick; over 80% agreed with the statement. One question addressed the use of technology as learning tool; over 80% of respondents said they found it easy to use the virtual environment for lecturing. In another question, addressing the application of a virtual environment for teaching and learning without time/space constraints, 66% of the respondents said they found the technology suitable for teaching. The remaining users had a neutral view about the application of technology. After establishing the user-friendliness of the technology, the application of the technology in a teaching environment was questioned. Teaching is not a simple process, and any technology can be put forward as a candidate for technology assisted learning.

To investigate the effectiveness of the Second Life virtual environment for teaching it was asked if it was easy to select different teaching methodologies within the learning environment; over 80% of respondents agreed with the statement. Based on the observed results it can be established that the SL learning environment is an effective learning tool which increases the overall learning experience of the user.

To a question asking about the overall learning experience within Second Life compared with the traditional classroom environment, 100% of the respondents found the virtual learning environment to be more relaxing than the traditional classroom. In response to a question investigating the interactivity between the teacher avatar and student smartbot, 100% of the respondents seemed satisfied with the means provided by the technology for the purpose of interaction. It was also investigated whether or not respondents were satisfied with the behavioural simulation techniques offered by the Second Life learning environment, and if these techniques were comparable with the traditional classroom environment and behavioural techniques. 100% of the respondents agreed that the behavioural and interactivity simulation environment offered by Second Life was comparable to the traditional teaching environment. In response to a question addressing the overall user experience of the Second Life virtual learning environment and its comparison to the traditional teaching environment, 100% of users agreed that they felt more comfortable in the

Second Life learning environment. From the current research it is evident that SL teaching is more useful than the traditional ways of learning and teaching through trainee teacher experiences, which is also supported by several studies (Lester & King 2009). From the results of the surveys and experiments it has been determined that SL offers an effective way of teaching students, and that the online version of a class is preferable to traditional face-to-face teaching. It is also commented that if a teacher employs web-based tools rather than traditional tools then students can have an effective overall teaching experience. The final result of this research leads me to conclude that Second Life, although it does not resemble a real classroom through face-to-face interaction, undoubtedly enhances trainee teachers' abilities and experiences dealing with smartbot services.

## 8.2 Contributions

The main contribution of this thesis in section (1:7) is to hypothesize a novel 3D classroom simulation for teachers using virtual learning environments and student behaviour such that trust inducing strategies as constructed through multiple data collection sources can be tested and analyzed, including a set of stages:

The first stage is producing a framework for the virtual classroom in the Second Life environment to get more experience in building trust for teachers and students, as well as simulating student behavior in the form of smartbots (robots) in the same environment; this is done by extensively collecting data in different forms to come to an all-encompassing conclusion regarding the construction of model which can be used to inculcate trust specific to SL environment and this is approved as a research limitation between avatars through teachers, observers, and smartbots, and then the kinds of behavior between them (see chapter 3). The second stage is based on transforming the requirements and strategic model into an actual SL system and then testing it based on constructed protocols, according to previous literary studies, is very important, especially to build a Second Life educational environment, which includes many educational islands and many other educational projects, carried out in the SL server. To this end, research carried out can be a benchmark in providing a harmonious way for SL classroom designers, engineers and teachers alike in defining the trust building techniques which can be practically implemented, that will be used most of the time in SL classrooms, such as management of behavior and feedback from students received as actions delivered by chatbot or email. Also, I looked at how best to evaluate the teacher performance through observational methods (surveys and case studies) that ultimately led teacher trainee performance levels in SL classrooms to attain better levels of trust. (see chapters 8 & 9). It is safe to assume that the constructed experiments and the accumulated data is one of its kind and presents a highly

unique solution for an array of stakeholders involved in the virtual education community. I have to say that cracking this nut required an obsession of digging deeper into multiple avenues and deriving techniques that have never existed before. However, the results and the data analysis throughout the thesis demonstrate that I have successfully accomplished this insurmountable task.

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