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Towards Understanding Human-Media Interaction: The Effect of the Young Users' Responses on Detecting the Symptomatology of Developmental Problems during Learning Tasks through Digital-Playground®

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Abstract

The present study was mainly conducting to explore the effect of the young users' responses on detecting the symptomatology of developmental problems during learning tasks through Digital-Playground®. This is especially when the young users act alone and without any sign of Human-Human Interaction (HHI) either before, during, or after learning process. The material was an isolated, computer-based learning environment that acts as a standalone learning environment and used by hundred preschool young users. The participants were randomly selected from ten preschools without revising their medical files.

In contrast with the previous work, the participants were distributed and classified by the system itself during progression in three essential groups. The results showed that the young users' response can be used to detect the natural development of inner-interaction and the symptomatology of the young users' developmental problems during learning tasks. The main conclusion was that, the young users followed three paradoxical views of cognitive development during learning tasks and the young users, themselves, can be diagnostic during learning tasks in which the natural development inner-interaction was fluctuated among three paradoxical views. To our knowledge so far, the results and conclusion have never seen in the literate before.

Keywords: Inner-interaction; Digital-playground®; Zone of user's interaction (ZUI); Self-vygotskyian's view, Self-piagetian's view; Self-aginian's view; Young user; Aginian's studies

Introduction

Vygotsky and Piaget were two prominent scholars within the area of cognitive development [1-15] for the sake of the simplicity, those studies will be referred as 'Aginian's studies' whenever it is necessary]. Their own theories of cognitive development have been influential in the development of theories of education. As reported by Meece [16], both scholars, Vygotsky and Piaget, took a constructivist approach to their research in cognitive development despite they have very different backgrounds, Vygotsky and Piaget believed that, "children must construct their own understandings of the world in which they live" [16]. Vygotsky believed that "children are born with elementary mental abilities such as perception, attention and memory" [16]. As children develop and interact socially with their culture and society, these innate characteristics are further developed. According to Vygotsky, one of the most important parts of cognitive development is language. Within this Vygotskyian's theory, language occurs in three stages: social speech, egocentric speech and inner speech. Social speech is just that: speech for the purposes of communicating (i.e., task-unrelated speech or undesirable-interaction [Aginian's studies]). Egocentric speech is more intellectual and children use this by speaking out loud to themselves [i.e., thinking aloud or spontaneous-interaction [Aginian's studies]). Inner speech is used by children to think in their heads about the problem or task at hand, instead of verbalizing their thoughts in order to decide what to do next [self-regulation or inner-interaction [Aginian's studies]). As concluded by Meece [16], Vygotsky was more concerned on "How a child interacts with his culture and society?" While in Piaget's research, the main goal was to answer the question, "How does knowledge grow?" Piaget did this through genetic epistemology, which is the study of cognitive development in children. Piaget focused on classification and relations, spatial relationships, time, movement, chance, number, conservation and measurement in concrete stages (Genetic Epistemology, 2006). Piaget viewed knowledge as "individually constructed" while Vygotsky viewed cognitive development as "socially co-constructed between people as they interact" [16].

Remarkably, the research in the literature concerning children's development, so far, can be simply divided into two main branches [Aginian's studies]. The first branch of the studies on children's development [17-21] followed the Vygotskyian's view that self-regulation (i.e., inner-interaction) is behavioral, appears after and as a result of regulation by others in a specific task and promoted by external regulators. The second branch of research on children's development [22,23] followed the Piagetian's view that self-regulation (i.e., inner-interaction) is psychological and promoted by giving children extensive opportunities to make choices and decisions.

However, both branches still rely on offering children external intervention (regulation/instructions) and guidance either before/during/after progression despite the fact that Piaget [24,25] argued that regulation by others hinders the development of self-regulation (i.e., inner-interaction). According to Piaget's theory, in order to adopt the

cognitive development, the educator should organize the class time with spontaneous mental activities to let learners develop their own ideas and to construct a healthy learning environment. To achieve this, Piaget encourages teachers to provide a role for social interaction and communication by presenting appropriate materials, drills, so that children can actively learn how to confront their physical and social world by living their own experiences. The present study took this point seriously in using special stimulus material (Digital-Playground®) that acts as a standalone learning environment where the young users can act alone without any sign of Huma-Human Interaction (HHI) or social intervention before, during, or after progression.

Consequentially, it is time to consider where we should go through in our future research to avoid repeating what is already available in the literature [Aginian's studies]. In specific, despite that massive body of the subsequent research regarding children's development in the literature, the research, up to date, still lacks a clear understanding of how can computer, as a nonhuman external regulator, be able to use and analyze the young users' responses to detect those young users with developmental problems associated with the natural development of inner-interaction.

This is particularly when the young user act alone and without Human-Human Interaction (HHI) or social intervention before/during/after progression. This topic has not potentially emerged yet in the literature in which the present study sought to shed a new light in terms of Human-Media Interaction (HMI). Stated differently, the present study was mainly trying to explore those children with developmental problems through analyzing their spontaneous responses during progression only with a computer and without their teacher, parents, caregiver, experimenter, etc. To our knowledge, this subject has never seen before in the previous work so far.

Critiques on reporting developmental problems

Over the past several decades [26-36] researchers found a significant link between problem solving and various measurements of psychological adjustment. Other researchers have become increasingly interested in looking at the link between social problem solving and adjustment [26,37,38] whereas a few studies have shown that social problem solving is also related to important positive psychological variables such as positive affect [39,40], life satisfaction [41], and psychological well-being [42] and also there has been a small, but growing literature, implicating a link between social problem solving and various health outcomes [39,40]. However, the major issue for mental health professionals is how to identify children's developmental problems at an early age because children, by themselves, cannot offer self-reports to report their mental status, and, therefore, their external regulators' views are not entirely objective as they are mostly subjective [43-46].

Therefore, most young children are not evaluated by a psychologist or psychiatrist until their problems come to the attention of someone of the external regulators. Noteworthy, when the symptoms of the DP reach the level of a diagnosable disorder in school-age children, they are relatively resistant to treatment [47,48] and, thus, the interventions aimed at preschool children may be more effective than those targeted at older children, both because the disruptive behavior is less entrenched and because behavioral control is emerging during this developmental period [49]. Behavior problems that become entrenched frequently lead to longstanding and severe life problems [50].

Various and different critiques on the previous work

One of the main problems the literature still faces is the use of much diversity of English terminologies to describe the same phenomenon without explaining why doing so [Aginian's studies]. Remarkably, even the leaders of the seminal research on children's development (Vygotsky in 1920s and Piaget in 1950s) were already vs. each other (i.e., paradoxical) about children's private speech, thinking aloud, and self-regulation. In specific, Vygotsky [51-53] which originally introduced the term inner speech, argued that private speech is a form of thinking, problem-solving, and self-regulation and hypothesizes that egocentric speech turns into inner speech and does not "fade away" but, instead, "goes underground". Piaget [25] which originally introduced the term egocentric speech, argued that private speech lacks a target person and believes that egocentric speech simply "fades away" as the child becomes less egocentric and more socialized.

Analytical Critiques: According to Vygotsky, Piaget fails to see the transition from "egocentric speech" to "inner speech" and according to Piaget, there is nothing called "inner speech" as Vygotsyk believed. Accordingly, the subsequent research described and defined Thinking Aloud under many names such as Verbal Reports, Concurrent Verbal Protocols, Retrospective Verbal Protocols, After Think-Aloud, Verbal Protocols, and Kid-Reports without any explanation why doing so [54] as the researchers also used many alternatives to define Private Speech such as self-verbalization (Duncana and Cheyne),self-directed speech, Task-related Speech [55], and, most recent-ly, self-talk [56] without explaining why those alternatives if all of them are essentially and already referring to the same phenomenon [Aginian's studies]. The recent research in HMI [Aginian's studies], concluded that the types of the interaction are also referring to the same developmental phenomenon. Specifically, private speech, task-related speech, and compulsory-interaction are the same phenomenon; social speech, task-unrelated speech, and undesirable-interaction are the same phenomenon; thinking aloud and spontaneous-interaction are the same phenomenon; self-regulation and inner-interaction are the same phenomenon. The most important point is that the diversity of English terminologies that describe the same phenomenon will not lead to a real revolution!

Technical Critiques: From a technical point of view, when using computer in the studies concerning developmental problems, the young children, generally people, with developmental problems are usually facing difficulties using standard input devices (i.e., mouse, keyboard, trackball) especially with pointing tasks [Aginian's studies]. In specific, common pointing problems for children with developmental problems include inability to aim at small targets, difficulty moving the pointing device, and difficulty controlling the pointer's buttons such as the inability to press the buttons or moving the cursor from the target after clicking.

Practical Critiques: From a practical point of view and as reported in the literature [Aginian's studies], one of the main reasons to explain the computer's inaccessibility to these individuals is that, most computer standard input devices are designed for the mainstream population without taking into account the fact that the input devices might also be used by people with developmental problems who generally face computer operation problems [57-60]. Thus, such people have limited access to the growing number of well-designed programs available to computer users, unless their computers have specialized alternative input devices [61,62]. From an experimental point of view, one of the most common experimental steps that appears as an inevitable in the previous work of chil-dren's behavioral regulation is

that the researchers were usually specified and divided the samples in advance either by primary diagnosis, or between children with or without such a status/condition in the form of condi-tion-A vs. condition-B to test such a hypothesis that already proposed and stated in advance too. This experi-mental design achieved without realizing the fact that the individual and intellectual characteristics are changeable during learning tasks in which the child's mental status may or may not be intellectually changing from one task to another during the progression. This process has a great influence on the final results where the research-ers/experimenters may be deceived [Aginian's studies].

Methodological Critiques: From a methodological point of view for studying the effect of HMI on young users' interaction behavioral development [Aginian's studies], still there is a great gap needs to be filling up given the fact that the literature still clearly lacks a clear understanding of how can computer, per se as a nonhuman external regulator, be used at an early developmental investigations concerning the young users' symptomatology of developmental prob-lems in terms of detection, classifications, identification, and diagnosis. This topic has not potentially emerged in the literature yet despite the large and huge body of the research that usually and regularly used the computer in the form of games and/or educational/learning tools to investigate various and different aspects/concepts and ideas that all return back to Vygotsky or Piaget [17-22].

Accordingly, the most appropri-ate question, probably, is not whether a machine can do psychotherapy or even whether it can do psychotherapy as perfect as a human and, therefore, it is certainly not whether a computer should do therapy (Spero, 1978). Instead, what precisely we need to know is whether a machine, as a nonhuman external regulator, can do any-thing useful/valuable for the young users who really need help with the sorts of developmental problems that bring them to the specialists and counselors at an early age for whatever the machine process may be called [Aginian's studies].

Designing Critiques: From a designing point of view, most of the available ready-made edutainment in the market nowadays, if not all, were designed by adults (i.e., young users were not engaged as a design-partners). Thus, the result in the literature regarding young users' behavioral development, so far, still repeats itself with no major change in terms of a new revolution in studying young users' interaction behavioral development [Aginian's studies]. In terms of educational psychology, the young users should not get any training on how to use the stimulus materi-al to avoid distorting their cognitive overload before running the actual experiment (i.e., the natural process of the young users' spontaneous-interaction will be negatively affected either by the edutainment fashion and/or stylish or socially by the teacher/experimenter who trained the young users). Therefore, the stimulus material, per se, has to be smart enough to run such a friendly-chat questionnaire whenever needed but without creating any overloading to the young user's current cognitive or thinking processes.

Psychological Cognitive and Meta-Cognitive Critiques: Psychologically [Aginian's studies], the "fashion and stylish" interface does not mean the product will be definitely accepted by the young users especially when the gender, just for instance, has conducted as an independent key! Many and many experiments were failed because of the adult-based design as many others failed because of the difference between the game's hero gender and the young user [Aginian's studies]. Cognitively, the stimulus material has to consider the negative effect of the Children's Split Attention (CSA) as well as the Children's Cognitive Overload (CCO) during progression. Otherwise, there will be no chance to separate the verbalization of the young users' private speech (i.e., compulsory-interaction) from social speech (i.e., undesirable-interaction) and thinking aloud (i.e., spontaneous-interaction), which are the keys that describe and clarify the content of the children's feeling and thoughts. Meta-cognitively, thinking aloud (i.e. spontaneous-interaction) is more accurate that the young users are spontaneously following to describe their feeling and thoughts whereas feeling and thoughts control the young users' interaction behavior development. Most importantly, young users' feeling and thoughts can only be obtained and measured by their speech and, more accurately, through thinking aloud (i.e. spontaneous-interaction) verbalization that should be spontaneously occurred and without instructing them to do so, which is the problem that still remains so far [Aginian's studies].

The Rationale of the current study

As reported in the literature [Aginian's studies], the previous researches, up to date, still relay on a human (i.e., teacher, instructor, experimenter, etc.) as an external guidance/regulator not only to control the experiment, but also to control the delivery of the interactional voices of encouragement cues especially during the progression. Therefore, they relied on HHI to offer the training session on how to use the stimulus material before the actual experiment starts. Moreover, the literature still lacks such a research that uses computer, per sec as an analyst of the young users' responses during progression to detect those who hold symptomatology of developmental problems associated with the natural development process of inner-interaction.

This is especially without using any sign of HHI before, during, or after the progression through special stimulus material (i.e., Digital-Playground) that acts as a standalone learning environment. In specific, the literature, up to date, still lacks investigating the effect of computer's regulation on young users' responses to detect young users' symptomatology of developmental problems associated with the natural development process of inner-interaction through a Digital-Playground when the young users act alone and without any sign of HHI or social intervention before, during, or after progression. To our knowledge so far, there is no study yet that analyzed the natural development process of inner-interaction based on Vygotsky's- vs. Piaget's view to detect the symptomatology of the young users' developmental problems.

The research expectations and main questions

The present study assumed two different expectations. Each expectation is associated with a research question as following:

Expectation (1): During progression with Digital-Playground®, the participants' responses can be used to detect the natural development process of inner-interaction.

Question (1): Are the participants' responses valid indicator to detect the natural development process of inner-interaction?

Expectation (2): During progression with Digital-Playground®, the participants' responses can be used to detect the symptomatology of their developmental problems.

Question (2): Are the participants' responses valid indicator to detect the symptomatology of their developmen-tal problems?

Expectation (3): During progression with Digital-Playground®, the participants' responses have a great influ-ence on their' satisfaction.

Question (3): During progression with Digital-Playground®, to what extend do the participants' responses affect their satisfaction?

Material and methods

Notice worthy, the present study can be seen as an extension of the Aginian's studies in terms of HMI. Thus, no change will be happened in the experimental design, participants, stimulus material, procedure, and data gathering. The conclusion will be deeply analyzing to explain the effect of young users' responses on detecting the symptomatology of developmental problems through a Digital-Playground® especially when the young users act alone, and, without any sign of HHI either before, during, or after learning tasks.

Participants

Because there were no preconditions that could be used to classify the participants into groups prior to the experiment and because of the use of the Digital-Playground® (the study's material) to classify the participants during progression based on their responses, the participants were randomly selected from ten preschools in Tripoli (10 children from each preschool, five boys and five girls produced the total of 50 boys and 50 girls). In contrast with the previous work, the school medical files of the participants were NOT revised and, therefore, the teachers were clearly asked to never pay attention to the participants if they already hold some psychological problems or intellectual disabilities such as the Attention Deficit Hyperactivity Disorder (ADHD) or similar challenges such as the Autism Spectrum Disorders (ASD) or any other psychological or social problems such as the interaction with others or difficulties in reaction. The teachers were also clearly asked to never ever offer any details about any participant as they were clearly asked to engage some children with any of those psychological/social problems without noticed the experimenter to enable him (the experimenter) to select five boys and five girls randomly. It is important to mention that many participants with common problems such as

ADHD and ASD are involved in regular preschools as most of the children's parents do not agree to register their children in schools for children with special needs despite the existence of many special schools in Tripoli (i.e., the policy in this country does not obligate the children's parents to register their children in special schools). Noteworthy, all the participants' parents were fully agreed to engage their children in this study.

The stimulus material (Digital-playground®)

The Digital-Playground® was a computer-based edutainment program presented as an isolated, computer-based learning environment that does not require the participant to gain any previous training or any experience of how to use the computer and, simultaneously, prevents the intervention of HHI before/during/after progression. The Digital-Playground® was specifically implemented for Aginian's studies and no other study uses it so far. In total, 20 tasks were selected among the developed tasks in close cooperation with various preschool teachers and based upon the children's daily classroom activities. The tasks were also evaluated by a number of children through a pilot investigation that involved 103 children and eventually revised by experts in teaching. The tasks were a collection of puzzles, numbers matching, social activates and picture-arrangement in the form of problem-solving (Figure 1).

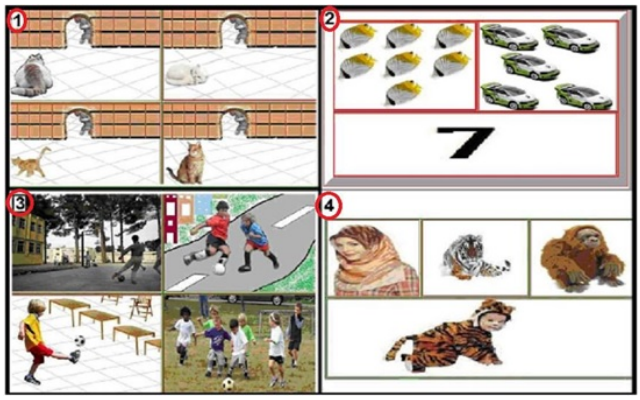

Figure1: Examples of the selected tasks by the teachers and implemented in the Digital-Playground®

The Progression of the Digital-Playground®: The progression of the game was based on two conceptual concepts. First, the teachers selected the tasks based on Vygotsky's Zone of Proximal Development (ZPD) that says "children's (i.e., young users') interaction only occurs when the task is located within the range of their ability and will be less frequent or absent when the task is too difficult". Second, the teachers ordered the selected tasks based on the Zone of Users' Interaction (ZUI), which defined in the present study as "the gap between self-interacted learner and the need to be interacted to learn". In specific, the tasks of the Digital-Playground® were selected by the teachers' experience based on the ZUI that produces ten simple and ten difficult tasks and ordered them as motivated and unmotivated tasks based on the ZUI in which the young users became able to face the difficult tasks without seeking any help from the human external regulator (Figure 1). It is very important to realize that all the participants have the same sequence of tasks (i.e., the Digital-Playground® introduces the same tasks in the same sequence and order of all the participants but not randomly). Because no previous training was offered to the participants, as an effort to avoid any HHI before the experiment, the Digital-Playground® began with the instruction "Touch the correct sign with your finger to start the game" spoken first by the animated Princess and repeated by the animated Superman on a continual loop for 5 minutes or until the participant reacted (Figure 2, Picture 1). If the participant did not react within 5 minutes, he, himself, ended the experiment. If the participant agreed to start, an animated and musical introduction (Figure 2, Picture 2) then prepared the participant to engage and introduced the main stimuli of the game (Princess, Superman, time-line allotment and the bell, which was used by Superman to tell the participant that the time allotted for the task had ended).

After the young user entered, the Digital-Playground®, through the Princess, introduced two additional simple tasks related to the child's gender ("If you are a boy, touch the boy's picture, and if you are a girl, touch the girl's picture".) and the young user's favorite color ("Touch your favorite color") without mentioning the statement "with your finger" to ensure that the young user was perfectly able to point to the correct item using his finger and to warn him to pay attention to the progress of the task allotment time (Figure 2, Picture 3).

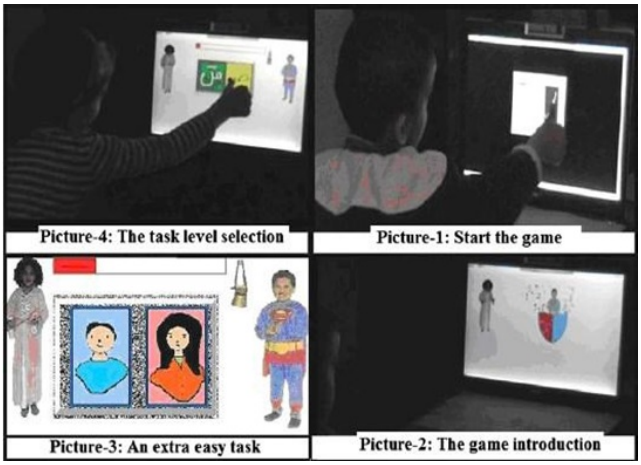

Figure 2: The Digital-Playground® prepares the participants to interact.

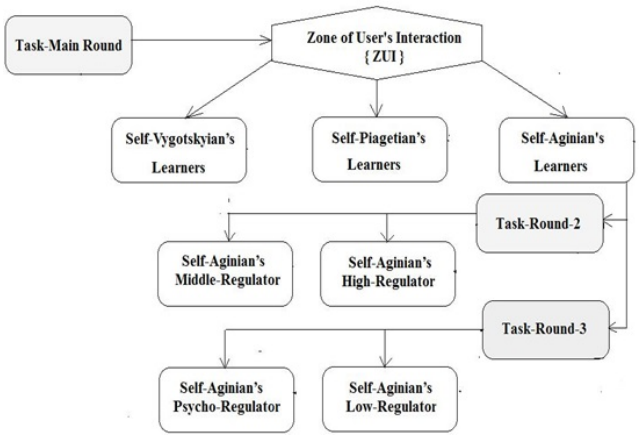

Figure 3: Detecting the participants with developmental problems through the natural development of the participants' inner-interaction

Simultaneously, Superman was verbally warned the young user that he (Superman) is always ready to offer more help if the task is not easy to understand by touching him (i.e., the young users were made aware that by touching Superman during the progression, they get more help about the current task). The young user, however, had to react to each task within a minute; otherwise, he ended the experiment denoted that the experimenter should replace this participant by another one. Stated differently, the young user had to ensure his participation with his full 'free-will' by reacting to the two extra easy tasks, which already were classified by the teacher, regardless the task precision (correct/incorrect). The game allowed the young user 60 seconds to choose the task level (more simple/difficult) and another 60 seconds to answer the task itself. This is the regular time given by the teachers at the school to the young users to act/react. The Digital-Playground® followed the same behavior to avoid the young users to bother because of the allotment time. Before each task, the Princess asked the young user to select (i.e., make a decision) about the next task level (more simple/difficult). Technically, the game introduced two boards at the middle of the screen while the Princess verbalized: "Touch the green board for the easier task or the yellow board for the more difficult task" (Figure 2, Picture 4).

The experimental design

Detecting the Natural Development Processes of the Young Users' Inner-Interaction: Technically, the Digital-Playground®, through the Princess, started by reading the current task and, simultaneously, Superman was ready to offer more explanation to the participant about the current task in case the participant requested extra regulation/help by touching Superman. The Digital-Playground® involves three different task rounds that enable the computer to classify the participants into three main classes and four sub-classes using Zone of User's Interaction (ZUI) as shown in Figure 3.

Task-Main-Round: the Participants' Main Classification: In the 'Task-Main-Round, if the participant `touched Superman for an external regulation/help during the current task progression, the game was classified the current participant as one of the self-Vygotskyian's learn-ers given the fact that the participant was spontaneously applied Vygotskyian's view of inner-interaction development that inner-interaction (i.e., self-regulation) is promoted by the external regulators in which Superman was applied the role of the external regulator. However, the game was NOT ensured this classification unless the participant answered the presented task and regardless the task precision (i.e., reacting to the task was an inevi-table condition for the game to ensure the participant's classification for whatever the task's answer was either correct or incorrect). In contrast, if the participant reacted to the task without touching Superman for an external regulation/help, the game was classified the current participant as one of self-Piagetian's learners given the fact that the participant was spontaneously applied the Piagetian's view of inner-interaction (i.e., self-regulation) that the external regulation hinders the inner-interaction development in which the participant did not ask for an external regulation. However, the game was NOT ensured the participant's classification as a self-Piagetian's learner unless the participant reacted to the task for whatever the participant's task precision was (correct or incorrect). It is very important to realize that the task precision (correct/incorrect) in the 'Task-Main-Round' has nothing to do with the participants' main classifications but, instead, the participants' response to the task was an inevitable condition.

Given the fact that the participant, on one hand, may left the task time running to intentionally monitor what exactly is going to happen if he did not make any action, which is absolutely a degree of inner-interaction that definitely cannot be identified at the this round, and the fact that the participant, on the other hand, may left the task time running because he was unable to regulate 'himself' to act or even able to understand what is really going on, which is also a degree of inner-interaction, (i.e., the participant holds unknown classification of inner-interaction), the present study, and for the sake of the clarity and simplicity, introduced and named this partici-pant as a self-Aginian's learner because the participant is already neither a self- Vygotskyian's learner nor a self-Piagetian's learner at the current round.

Zone of user's interaction (ZUI)

Thus, during progression the natural developmental process of inner-interaction may be one of the three classifications: either a self-Vygotskyian's learner, self-Piagetian's learner, or self-Aginian's learner in which this process, and for the sake of the clarity and simplicity, was introduced and named as the "Zone of User's Interaction (ZUI)" and defined as "the equilibrium point in the inner-interaction's development process that controls the participant to be either a self-Vygotskyian's learner, self-Piagetian's learner, or self-Aginian's learner during progression". However, if the participant did not react to the current task within the allotment time (60 s), Superman ended the task by ringing the ball as a sign of 'the task allotment time is over' and simul-taneously, the Princess turned back as a sign of 'unsatisfied' about the participant's reaction, which was an at-tempt to motivate the participants to react when they stayed at ZUI along the task allotment time without any action (Figure 4).

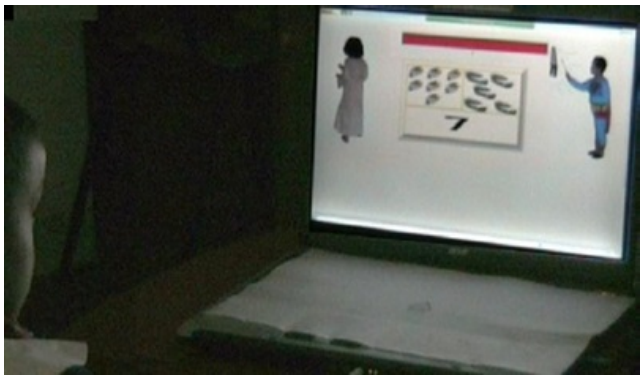

Figure 4: Motivating the participant when he stays at ZUI for long time

After 10 seconds, the Digital-Playground® introduced the same task once again and the Princess was ver-bally and clearly warned the participant that "If you do not react, this task will be introduced once again and again over" to motivate the participant to never leave the task without reaction as he did in the 'Task-Main-Round'. The game, however, was not warned the participant about the remaining of the task allotment time to avoid distorting the young user's cognitive process during the progression and, therefore, monitoring the learning process simultaneously with the performance is one of the main characteristics of self-regulation (inner-interaction) in the Aginian's studies (2008-2015).

Task-Round-2: the Participants' First Sub-Classification: After the 'Task-Main-Round' ended by the game, the second round was started (hereafter: 'Task-Round-2') in which the participant's reaction and the task precision were the key element of the sub-classification of the participants. Specifically, if the participant reacted to the task in this round 'Task-Round-2', the Digital-Playground® was marked this participant as a self-Aginian's high or middle learner based on the task precision (correct/incorrect) respectively given the fact that this participant realized that the system will not introduce a new task as long as he does not answer the current 'repeated task' that, in turn, leads to the fact that the partici-pant was intentionally left the time ran at the first round (Task-Main-Round) to monitor what is going on if he did not react in which the task precision was the judge between the participant to be either a high or middle self-Aginian's learner. Accordingly, if the participant answered the current task correctly, the present study, and for the sake of the clarity, refers to this participant as a Self-Aginian's High-Regulator and defined him as "the learner who clearly plans to monitor what will happen next to the current progression and answers the current task correctly". In contrast, if the participant answered the current task incorrectly, the present study refers to this participant as a Self-Aginian's Middle-Regulator and defined him as "the learner who clearly plans to mon-itor what will happen next the current progression and answers the current task incorrectly". However, if the participant did not react to the task at this 'round (ask-Round-2), the Digital playground® was instantly moved and applied the last round (hereafter: 'Task-Round-3') to specifically define and classify this participant in terms of holding or not holding developmental problems for whatever that problem exactly is.

Task-Round-3 Participants' Second Sub-Classification: In the 'Task-Round-3' the game was repeated the same task for the third and last round whereas the Princess was verbally and clearly warned the participant that "If you do not react this time, the task will be ended and the entire game will be over" to bring the participant's attention that there will be no more play with the game unless he reacted to the task. In this 'Task-Round-3', Superman was ringing the bell once each 15 seconds to nonverbally keeping the participant warned during the task allotment time (60 seconds). If the participant reacted to the task, the game was classified this participant as a low class of inner-interaction learner given the fact that the participant already left two rounds (i.e., 'Task-Main-Round' and 'Task-Round-2') without any reaction and only reacted when he received warning. For the sake of the clarity and simplicity, the present study refers to this participant as a Self-Aginian's low-regulator and defined him as "the learner who is able to moni-tor the current learning process only with warning". However, if the participant did not react to the task at this 'Task-Round-3', the game was classified this participant as holding developmental problem given the fact that the participant does not realize that the computer will not introduce another task as long as he does not react to the current task and, therefore, he does not realize the fact that the game will be over too! For the sake of the clarity and simplicity, the present study named this child as a Self-Aginian's psycho-regulator and defined him as "the learner who is fully unable to monitor the current learning process even with warning".

Analyzing the young users' task responses

The Digital-Playground® used special computer agent program called AMA-CLASSIFYING as a process to count the occurrences of how many times the participants did develop inner-interaction as self-Vygotskyian's learners, self-Piagetian's learners, or self-Aginian's learners during progression. This means that the computer agent program AMA-CLASSIFYING already had 2000 responses to be analyzed (i.e., 20 tasks for each partici-pants in the total of 100 children produces 2000 responses during progression). In simple words, among the 2000 responses, the system analyzed the fluctuation of the participants by counting the frequencies of how many times the participants developed inner-interaction as self-Vygotskyian's learners, self-Piagetian's learners, or self-Aginian's learners during the three proposed rounds (Figure 3).

Scoring the extent the stimulus material helps children to respond

The Digital-Playground® involved a computer agent called AMA-CHAT, which used to control a friend-ly-chat questionnaire to find out

the extent the system helps the young users to response during progression. Specifically, to avoid the external intervention and any sign of HHI after the session, the Digital-Playground® was attached with a friendly-chat questionnaire with the Princess and Superman that involved eight simple questions, which were developed with closely cooperation with the teachers, for the participants to describe their feelings about the system. First, Superman was opened the conversation by informing the participant that he (Superman) and the Princess would like to chat with him (the participant) about the game because he (the participant) showed a high level of intelligence and could help to improve the game (this is regardless of his actual achievement and as a motivation for the participants to respond exactly as the teachers followed in the class-room). Superman asked the participant whether he would like to chat with them by touching the correct/incorrect (agree/disagree) sign in the middle of the screen (Figure 5).

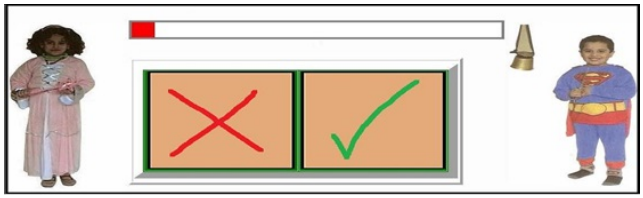

Figure 5: The start of the friendly-chat questionnaire

If the participant agreed, the Princess first told the participant that whenever he did not understand the point, he should touch her or Superman once again to repeat the explanation. For the next question, Superman asked the participant to touch the correct sign once again to chat with him about the game and when the partici-pant agreed, Superman explained but not directly asked the question (exactly as the teachers follow in the class-room). To get the participant's answer, the computer, through Superman, warn the participant to confirm his answer (agree/disagree) by touching the green/red cycle after each question (Figure 6).

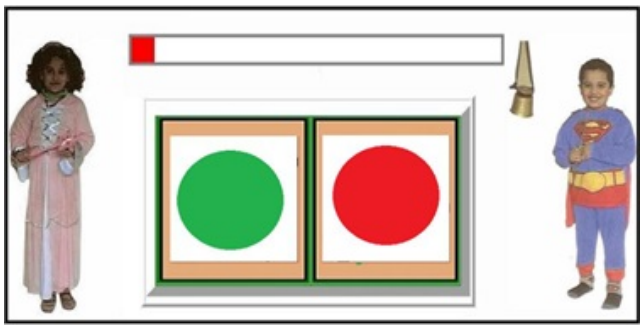

Figure 6: Agree/Disagree for the questionnaire's answers

In contrast with the previous Aginian's studies (2011a, 2011b, 2011c and 2011d), the Digital-Playground® was continued with the next question if the participant did not react to the previous one because it was expecting that the participants with developmental problems may not react at all. In specific, the system did not finish the game until the last question even if the participant declined to chat at any question whereas the allotment time of each question for the participant to react was 120 seconds (i.e., the entire questionnaire required 16 minutes, which was the allotment time to finish the questionnaire). After finishing the questionnaire, the Princess moved the game to the reward session, which was the last session. Each participant was rewarded with a piece of chocolate (Snickers/Kit-Kat), which were the favorites among the participants as their teachers mentioned (Figure7).

Figure 7: The Digital-Playground last session

Finally, the Princess and Superman thanked the participant and informed him that he did very nice job with a high performance and ensured him that when the room light comes on, he will receive the chosen chocolate. Meanwhile, the experimenter and teacher switched the light on and delivered the chosen reward to the participant and thank him for his participation too.

Data gathering

Despite the system's ability for gathering data on different and various factors through special SETUP program, the present study was only aiming to examine the effect of the participants' responses on detecting those participants with developmental problems through the natural development of inner-interaction in which scoring the extent the game helped the participants to response through the computer agent AMA-CHAT was the only psychological factor needed to be analysed. In specific, the Digital-Playground, through the SETUP program, gathered data through a collection of computer agents, such as the exact time the participant started the game in milliseconds, the chosen task level, the actual task level, the level response time in milliseconds, the task precision (correct/incorrect answer) answer's response-time in milliseconds, the degree of the manifested inner-interaction as a function of the task level selection and as a function of the task precision generated by the agents AMA-GUIDE and AMA-SCORE respectively, the overall performance among conditions (if any) through the agent AMA-PONIT and the feedback of the friendly-chat questionnaire generated by the agent AMA-CHAT, which was the most important factor in the present study. For the sake of the accuracy, the video recording for all the participants was reviewed for more psychological and observational analysis and to ensure that the participants were acting perfectly till the end of the experiment. Noteworthy, despite most of the data gathered was not used in the present study; that data was an essential and fundamental factor to guide what the future work should focus on.

Procedures

Almost at any preschool in the city of Tripoli, which already holds more than hundred public preschools, there is usually, but not at each preschool, a special experimental room ready for any experiment. This room is usually located in a quiet corner, mostly, with the same equipments: a child-sized chair, an external touch-screen (17-in.) used to avoid any possible coordination problems for the children connected to a laptop computer with two hidden portable video cameras and, therefore, it was not hard to get any other equipment. The first camera captured the entire environment, and the second offered a clear view of the task on the screen and the child's face (Figure 8). An extra small microphone was connected to the second camera for better audio recording.

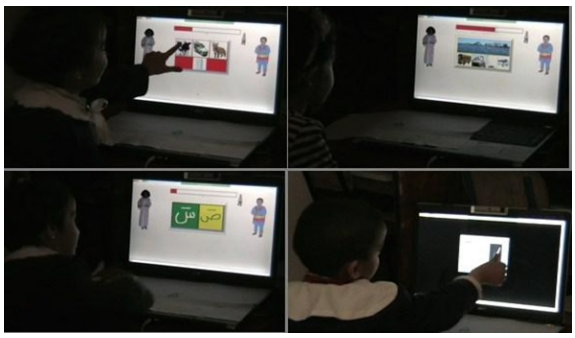

Figure 8: Examples of video capturing during progression with the Digital-Playground®

The Participants, however, were kept unaware of the cameras and the microphone to avoid the problem of the splitting attention that could lead to undesirable cognitive processes. Each participant attended a session of 5-minutes welcome in the meeting room but did not receive any training on how to use the game. Instead, the participants were made aware that the game requires a smart player to complete the tasks and that the experi-menter was only presented to watch their performance in order to reward them. The participants were also made aware that neither their teacher nor the experimenter would know the answers and they cannot offer any help. All sessions for all days were held in the morning at 09:15 AM (i.e., the first participant started at 09:15 AM and the second started after the first one and so on) as the teachers recommended. The actual experiment ran with five children per day and the entire experiment required 20 days to accomplish.

Results

The present study was conducted to extend the study that originally conducted as an extension to Aginian's studies. It was mainly examined the effect of the young users' responses on detecting those young users who hold the symptomatology of developmental problems during learning tasks with especial Digital-Playground®. This is specifically when they act alone and without any sign of HHI or social intervention before, during, or after the progression.

Detecting the natural development of the participants' inner-interaction (1st Research question)

The first research question addressed hd to do with detecting the natural development process of inner-interaction through the participant's responses. The computer, through Digital-Playground®, was successfully able to detect and classify the participants in terms of the natural development of inner-interaction during pro-gression. In specific, the computer agent AMA-CLASSIFYING generated all the proposed classes successfully and, therefore, counted the number of the participants (boys and girls) in each class as shown in Table 1.

During the task-main-round					
Self-vygotskyian's learners		**Self-piagetian's learners**		**Self-aginian's learners**	
(n = 38 Participants)		(n = 40 Participants)		(n = 22 Participants)	
How many times the participants		How many times the participants		How many times the participants	
developed inner-interaction as		developed inner-interaction as		developed inner-interaction as	
Self-Vygotskyian's learners?		Self-Piagetian's learners?		Self-Aginian's learners?	
Boys	Girls	Boys	Girls	Boys	Girls
(n = 18)	(n = 20)	(n = 21)	(n = 19)	(n = 15)	(n = 7)
357	398	425	378	287	155
-18%	-20%	-21%	-19%	-14%	-0.08%
	755		803		442
	-38%		-40%		-22%

Table 1: Classifying children into three main classes during learning progression

Detecting the participants with developmental problems (2nd Research question)

The second research question addressed had to do with detecting whether the participants' responses a val-id indicator to detect the symptomatology of the young users' developmental problems associated with the natu-ral development of inner-interaction during progression. The computer agent AMA-CLASSIFYING generated all the proposed sub-classes of the self-Aginian's learners successfully and, therefore, counted the number of children (boys and girls) in each class as shown in Table (2).

Self-aginian's learners							
(n = 22 children)							
How many times children developed SRL as Self-aginian's learners?							
Task-round-2				**Task-Round-3**			
Self-aginian's		**Self-aginian's**		**Self-aginian's**		**Self-aginian's**	
high-regulator		**Middle-regulator**		**low-regulator**		**psycho-regulator**	
(n = 4)		**(n = 6)**		**(n = 7)**		**(n = 5)**	
Boys	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**
(n = 3)	(n = 1)	(n = 4)	(n = 2)	(n = 4)	(n = 3)	(n = 4)	(n = 1)
61	25	80	39	68	61	78	30
(-0.03%)	-0.01%	-0.04%	-0.02%	-0.04%	-0.03%	-0.04%	-0.01%
86 (0.04%)		117 (0.06%)		131 (0.07%)		108 (0.05%)	
442(22%)							

Table 2: Classifying Aginian's learners into four sub-classes during learning progression

The extent the participants' responses affect their aatisfaction (3th research question)

The third research question addressed had to do with the extent the participants' responses affect their satis-faction during progression. The agent AMA-CHAT showed that the self-Vygotskyian's learners and self-Piagetian's learners showed almost the same satisfaction during progression despite the slight difference in some factors (Table 3).

The friendly chat questionnaire during progression (To what extent did the participants feel comfortable during progression?)	**The participants' responses**										
	Self- vygotskyian's learners (n = 38)		**Self-piagetian's learners (n = 40)**		**Self-aginian's High-aegulator (n = 4)**		**Self-aginian's middle-megulator (n = 6)**		**Self-aginian's low-regulator (n = 7)**		**Self-aginian's psycho-regulator (n = 5)**
(1) The game is easy to use.	38 (100%)	-	40 (100%)	-	4 (100%)	-	6 (100%)	-	-	7 (100%)	No reaction
(2) It is easy to select the task level.	38 (100%)	-	40 (100%)	-	4 (100%)	-	6 (100%)	-	7 (100%)		No reaction
(3) All tasks are difficult.	11 (29%)	27 (71%)	9 (22%)	31 (78%)	-	4 (100%)	3 (50%)	3 (50%)	7 (100%)	-	No reaction
(4) The task time is enough.	22 (58%)	16 (42%)	40 (100%)	-	4 (100%)	-	4 (67%)	2 (33%)	2 (29%)	-	No reaction
(5) You will play this game once again.	29 (76%)	9 (24%)	33 (83%)	7 (18%)	4 (100%)	-	6 (100%)	-	7 (100%)	5 (71%)	No reaction

(6) You will recommend this game.	34 (90%)	4 (10%)	36 (90%)	4 (10%)	4 (100%)	-	6 (100%)	-	4 (57%)	-	No reaction
(7) You like this game.	36 (95%)	2 (.05%)	38 (95%)	2 (.05%)	4 (100%)	-	6 (100%)	-	6 (86%	1 (14%)	No reaction
(8) You want the teacher [teacher's name] to be with you to finish the tasks.	-	38 (100%)	-	40 (100%)	-	4(100%)	-	6 (100%)			No reaction

Table 3: The extent the stimulus material helps children to respond

In contrast, the self-Aginian's learners showed completely different degree/level of satisfaction during learning tasks. The self-Aginian's high-learners showed the highest level of satisfaction in all terms especially that they did not mention any difficulty in all the given tasks (see third question in Table 3) whereas the unique and the 'unusual' result was that the self-Aginian's psycho- learners did not show any reaction for all questions (i.e., they did not agree to chat with Superman and Princess). The self-Aginian's middle and low learners showed different reactions in which they were gained the lowest level of satisfaction. The self-Aginian's psy-cho-learners, therefore, did NOT choose any reward (see again Figure 7).

Discussion and conclusion

Given the fact that the development natural of inner-interaction is changeable and different from one task to another [Aginian's studies], the present study was mainly conducted to explore the effect of the young users' responses during learning tasks on detecting the symptomatology of developmental problems when young users interact with Digital-Playground®. This means that the developmental problems may also be changeable and different from one task to another that makes the participant may or may not be intellectually or even temperamentally changing from one task to another during the progression. In sum, the present study shows that the computer, through Digital-Playground®, could react as a quasi-psychological analyst as expected to be (even to a specific extend). First, the computer, through the first round of progression, was able to detect and count how many times the participants developed inner-interaction as self-Vygotskyian's learners, self-Piagetian's learners, and self-Aginian's learners. Second, the computer, through the second round of progression, was able to sub-classify and count the participants based on how many times they developed inner-interaction as Self-Aginian's learners. To our knowledge so far, this result has never seen in the literature yet.

The rational of the aginian's view (vygotskyian vs. piagetian vs. aginian)

Remarkably, both Vygotsky's in 1920s and Piaget's in 1950s theories of cognitive development pro-vide foundations for constructivist approaches to teaching and learning [16]. Nevertheless, Vygotsky and Piaget were paradoxical with each other concerning the final outcomes of the natural development of young users' or children's interaction! On one hand, Piaget believed that inner-interaction (i.e., self-regulation) is promoted by giving children extensive opportunities to make choices and decisions, to make rules by which they will regulate themselves. Piaget [24,25] also believed that inner-interaction is psychological presented from early infancy in the child's equilibration of actions, regulation by others does not have to come before inner-interaction (i.e., self-regulation) in a specific task and argued that regulation by others hinders the development of inner-interaction (i.e., self-regulation). Vygotsky (1978, 1986/1934, 1987/1934), on the other hand, believed that in-ner-interaction (i.e., self-regulation) is behavioral appears after and as a result of regulation by others in a specific task and promoted by external regulators (i.e., regulation by others does NOT hinders the development of inner-interaction). Thus, Vygotsky and Piaget are completely paradoxical, which is the rational of Aginian's view. However, the Aginian's view is not at the same level of Vygotsky's- and Piaget's view as it is a clarifica-tion of the classification concerning young users' natural development of inner-interaction during progression when they act alone without any sign oh HHI or social intervention. In specific, during the natural developmen-tal of inner-interaction, it is a question that which views (Vygotskyian or Piagetian) of inner-interaction (i.e., self-regulation) is more nature for young users to follow during progression especially when the external regula-tor is a nonhuman (i.e., computer through Digital-Playground®)? Based only on these two paradoxical views (Vygotskyian vs. Piagetian), a number of important, sensitive, and inevitable questions have risen: (1): if the young user does not follow one of the two paradoxical views during progression, then what is that view the young user follows of the natural development of inner-interaction? (2): How should that young user be classi-fied if that young user is neither Vygotskyian's learner nor Piagetian's learner? (3): What view should be used to classify that young user?.

Given the fact that the young user may left the task time running to intentionally monitor what exactly is going to happen if he did not make any action/decision, which is an absolute degree of inner-interaction that definitely cannot be identified at Task-Round-1, and the fact that the young user may left the task time running because he could not be able to adequately regulate himself to interact or even be able to understand what is really going on because of an ambiguous developmental problem, the Aginian's view raises as an essential as fundamental classification for children's responses during learning tasks in terms of detecting the natural development of inner-interaction (see Figure 3 once again). Consequentially, it is a question that: is the Aginian's view psychological (i.e., supports Piagetian's view), behavioral (i.e., supports Vygotskyian's view), or temper-amental (i.e., stands alone as a fundamental classification that affected by children's temperament responses)?

Despite, the present study is currently unable to clearly answering this question yet, it is obviously does not con-firm the Vygotskyian's view that inner-interaction (i.e., self-regulation) is a result of external

regulation (that is because the young users can engage with computer, the nonhuman external regulator, without the need of the human's external regulation, HHI, or social intervention before/during/after the session). Simultaneously, the present study does not fully support to the Piagetian's view that external intervention hinders inner-interaction (i.e., self-regulation) development (that is because the young users receive help/regulation from the Princes and Superman as warning but, nevertheless, they left the task time running to intentionally monitor what is going to happen where some of them are classified as a self-Aginian's high-regulator). Accordingly, it is a motivational and challenged question is that: is the Aginian's view affected by the young users' temperament responses? In terms of priority, this question will be one of the highest subjects in our future work.

Why self-aginian's view is a fundamental class of the young users' responses?

The Zone of User's Interaction (ZUI) enables the computer, as a nonhuman external regulator, to be able to classify the young user in case the young user is neither a self-Vygotskyian's learner nor a self-Piagetian's learner. In this case, that user had to be classified as an Aginian's learner in which that young user may be holding unknown class of inner-interaction or such a developmental problem (i.e., holding such a psychological, behavioral, or temperamental problem). The ZUI, also, enables the computer to become able to clas-sify the Aginian's learners to be one of the four classes: self-Aginian's high-regulator, self-Aginian's middle-regulator, self-Aginian's low-regulator, or self-Aginian's psycho-regulator, which is the young user who definitely holds such a symptomatology of one of the developmental problems that might be a psychological, behav-ioral, or temperamental regardless what that developmental problem will be. However, the present study does not clarify that yet.

Given the psychological fact that the computer, as a nonhuman external regulator, starts activating the young users' process of inner-interaction development through several steps that all depend on the young user' free-will to act and react during learning tasks where: (1) the young user starts the game with his full free-will and without any previous training, (2) the young user becomes, in a fashion way and without distorting his cog-nitive process, aware about all the main components of the game through an animated and musical introduction, and (3) the young user ensures his participation spontaneously with full freewill and engages with the tasks without any complexity of how to use the game, it is very surprising that despite all the self-Aginian's learners follow all those psychological preparations, the self-Aginian's psycho-learners are fully disagreed to engage with the friendly-chat questionnaire (i.e., they do NOT agree to chat with the Princess and Superman to describe their feelings during progression as they do NOT agree to reward themselves at the end of the game).

While this result confirms that the computer, as a nonhuman external regulator, becomes able to detect those young users with developmental problems during progression that, in turn, confirms the Aginian's view to stand as a fundamental classification of the inner-interaction natural development, an actual and physical confirmation was inevitable and highly needed to ensure that fundamentality. Accordingly, all the school medical records (i.e., all the 100 medical records) have revised one by one and the investigation shows that all the Aginian's psycho-learners share the same problem of interaction with their teachers and classmates whereas three of them are even sharing the same problem with their brothers and sisters at home and only one of them is always setting alone even during the launch time and does not like to engage with the others based on the teacher's observational notes in the classroom and school. Therefore, the medical records shows that no one of all the participants suffers from the problem of the color blindness, which gives the results more reliability to be accepted especially during measuring the extent the game helps the participants to response. Moreover, the video recording of the welcome session is also revised for all the participants one by one and the observational result shows that no one of the five self-Aginian's psycho-learners says even a single word during the meeting whereas they, mostly, move their heads as a sign of their agreement associated with slight smiling (this point is currently under investigation for the future work given the fact that the present study is unable to explain that).

Diagnosis the young users' developmental problems through aginian's view

Obviously, the computer, as a nonhuman external regulator, in the present study is still unable to diag-nosis the exact developmental problems in details as it is only able to detect the young users who hold develop-mental problems. Accordingly, this investigation leads the future work to consider the following question: can computer, as a nonhuman external regulator, be able to diagnosis the exact young users' developmental problems especially when they act alone and without human–human interaction or social intervention during learning tasks in the classroom? Theoretically, this question is not really hard to be answered given the fact that the computer, in terms of programming, can hold a database file involves the symptomatology of each single developmental problem (e.g., ADHD, ASD, or whatever) and, consequentially, the Digital-Playground® marks the young user as holding this or that problem whenever that young user shows an indication or a set of indications (i.e., the exact symptomatology) that relate to this or that problem (it is not complicated). Practically, this work should be seriously taken into account and consideration given the medical fact that the major issue for mental health is how to identify the developmental problems at an early age professionally so the earliest remedy will be more valuable and effective. This practical investigation is currently under our longitudinal investigation, study, and analysis. The more complicated question that definitely makes the computer, as a nonhuman external regulator, to act as a psychologist, psychiatrist, or whatever it will be called, is that: can the computer, per se, be able not only to detect or diagnosis the symptomatology of that specific developmental problem but also to treat that problem during the time of the learning tasks in the classroom? This question emphasizes that what pre-cisely we need to know is whether a machine, as a nonhuman external regulator, can do anything use-ful/valuable for the young users who really need help with the sorts of developmental problem that bring them to the specialists and counselors at an early age for whatever the machine process may be called, for whatever the classifications may be named.

Supplementary analyses

After reading the current study, one may be assuming that the computer, as a quasi-human, is ultimate-ly able to diagnose some or even all the symptomatology of the young users' developmental problems; then SO WHAT?! Why using the computer is so important? Can the computer detect all the young users' developmental problems? Is there any need to refine diagnosis? Does the diagnosis determine a

best course of treatment for the young user at an early age better than what a real human would determine? Many other questions might be raised too in which the present study can be considered as an initial step to keep going this research (i.e., the key of the future work). By and large, the entire story of using computer, as a nonhuman external regulator, is concerning detecting the young users' developmental problems at an early age. This is especially when they act alone through computer Digital-Playgrounds using their spontaneous responses and without distorting their cognitive process during progression (i.e., during diagnosis process). That goal cannot be achieved with a human's external regulation because of the human–human interaction and social intervention. Diagnosis the young users' developmental problems through computer is so important not only because of the computer's attractiveness but also all kinds of diagnosis can be simultaneously achieved within a short time (i.e., within the time the young user needs to finish the game) in which a simple question can be asked: is there any specialist can determine the young users' developmental problems within a short time just like the computer does when the young users act alone and without any human's external regulation?

Very interesting and short extra answer is that the human specialists can be died but the nonhuman (i.e., computer) is an immortal soul! Consequentially, it is a question that: why we do not use this immortal soul to save our young users (children) given the fact that the time response is the most significant element to save our young users (children) from future consequences. Simply, we could imagine such a web application among all the specialists connected to all children including those who hold developmental problems where each specialist can feed this immortal soul with the feedback as a treatment based on the fact that our children are already fascinated by the modern technology that can be utilized to help them without distorting their cognitive load or their thinking process in the classroom or at home along 24 hours per day (can this project be done all over the world to help our children?!).

Limitations and future work

The present study is clearly suffering from the lack in the related previous work concerning the use of computer, as a nonhuman external regulator, to identify and detect those young users who hold developmental problems in which the previous Aginian's studies (2008-2015) are the most related researches. As this problem can be considered as a great limitation, it is also a motivational factor for the present study to be raised and to motivate the other researchers to introduce their abilities and ideas in implementing and designing new computer based methodologies that could help the future of the computer in psychotherapy. However, the present study does not precisely clarify whether the Aginian's view is temperamentally affected (i.e., by children's temperament responses) as there are many questions need to be deeply and clearly answered in which the following two questions remain the most important ones: (1) what evidence is there that playing the Digital-Playground® is diagnostic of the young users with developmental problems? (2) Can young users, by themselves, be diagnostics?!! These two questions and many others are the key factor to lead our current and future work.

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