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The effect of the external regulator's absence on children's speech use, manifested self-regulation, and task performance during learning tasks

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ABSTRACT

The present study was conducted to explore the effect of the absence of the external regulators on children's use of speech (private/social), task performance, and self-regulation during learning tasks. A novel methodology was employed through a computer-based learning environment that proposed three types/units of encouragement with only two sequences of instructional conditions, Verbal–Gesture–Silent (VGS) versus Silent–Gesture–Verbal (SGV). The Knowledge of response (KR) was applied as: verbal KR feedback with verbal encouragement during the verbal unit, visualization-representation of KR without verbal encouragement during the gesture unit, and no KR feedback without any encouragement during the silent unit. Three measurements were used: speech analysis, novel criteria to measure self-regulation and task performance, and a computer-based friendly chat questionnaire to measure children's satisfaction. Forty preschool children were divided by their teachers between the two conditions equivalently. It was hypothesized that children in the VGS condition were more speech productive, manifested higher self-regulation, task performance, and satisfaction. The results showed significant differential effect on the speech intensity and manifested self-regulation with no significant differential effect on task performance and satisfaction during learning tasks. However, the results were not confirmed Vygotsky's view as it were supported (neutralizing, at best) to Piaget's view of self-regulation development.

1. Introduction

Up to date, a few investigators have recently begun to explore early childhood teachers' beliefs about children's private speech (Deniz, 2004; Oliver, Edmiaston, & Fitzgerald, 2003). They have found that the kindergarten and first-grade teachers were aware of their children's private speech in the classroom and that teachers differed in their opinions on the role of the phenomenon. Recent research outcomes (Berk & Winsler, 1995; Winsler, Carlton, & Barry, 2000; Winsler & Diaz, 1995; Winsler, Diaz, Atencio, McCarthy, & Chabay, 2000; Winsler, Manfra, & Diaz, 2007) have recommended that teachers should encourage speech (in specific, only private but not social speech) among students to take advantage of its self-regulatory functions. However, despite the large body of research on private speech in the literature (Beaudichon, 1973; Behrend, Rosengren, & Perlmutter, 1989; Bjorklund & Douglas, 1997; Diaz & Berk, 1995; Duncan & Pratt, 1997; Fernyhough & Fradley, 2005; Gaskill & Diaz, 1991; Kohlberg, Yaeger, & Hjertholm, 1968; Lee et al., 1999; Siegler & Stern, 1998; Vygotsky, 1987; Winsler, De Léon, Wallace, Carlton, & Willson-Quayle, 2003; Winsler, Diaz, & Montero, 1997; Winsler & Naglieri, 2003; Winsler, Carlton et al., 2000; Winsler, Diaz et al., 2000) and the available evidence that students can learn to be more self-regulated (Zimmerman & Schunk, 2001), a clear understanding has yet to emerge on *how* and *when* the lower grade teachers should encourage students to talk and, most importantly, the effect of the fully external regulator absence on young children achievement has not been explored in the current literature.

1.1. Theoretical critique on children's speech use and manifested self-regulation

According to Piaget (1968) and the subsequent work (Flavell et al., 1966), social speech, as distinct from private speech, is addressed to a partner, whereas private speech lacks a target person. Vygotsky's research (Vygotsky, 1978, 1986, 1987) claimed that private speech constitutes a kind of thinking, problem solving, and enhances task performance and self-regulation, which has recently figured in research as a major concept described by various definitions and models. However, each definition and model of self-regulation in each area of knowledge was defined and introduced based on the researchers' theoretical background, perspective, and the need of their studies and they may also assume their

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definitions and models in advance or concluded them based on the results of their studies (Agina, 2008). In philosophy, for instance, the definition was based on self-control (Shonkoff & Phillips, 2000), in psychology the definition was based on self-management (Stright, Neitzel, Sears, & Hoke-Sinex, 2001), in cognitive science the definition was based on self-generated (Zimmerman & Schunk, 1989), in motivational learning the definition was based on self-motivation (Boekaerts, 1999), and recently in computer-gaming and self-regulation the definition was based on self-control (Agina & Kommers, 2008). Remarkably, the first branch of the studies on children's speech use and self-regulation (Fernyhough & Fradley, 2005; Girbau, 2002; Muraven, 2010; Tang, Bartsch, & Nunez, 2007; Winsler, Abar, Feder, Schunn & Rubio, 2007) followed the Vygotskyian view that self-regulation is behavioral, appears after and as a result of regulation by others in a specific task and is promoted by external regulators. Those studies still employed external intervention to instruct and guide the participants even before/during/after the experiment, typically in the form of prior training on how to use the material, encouragement through the external regulators to keep talking during the performance, or a questionnaire after the session. The second branch of research (DeVries, 1992; Kamii & DeVries, 1980) followed the Piagetian view that self-regulation is promoted by giving children extensive opportunities to make choices and decisions but still with external intervention through offering instructions and guidance to the participants despite the fact that Piaget (1932) argued that regulation by others hinders the development of self-regulation.

To date, researchers continue to support their participants with explicit instructions during learning tasks to talk aloud and prompt them when they are silent for long periods. This practice is not recommended, as it places artificial constraints on the situation, changes the cognitive processes and task activities required, and distorts the natural spontaneous emergence of private speech, which is usually the desired behavior under study (Daugherty, White, & Manning, 1994). To be sure that the subject actually reports his mental states without distorting them, it is important that the subject does not feel that he is taking part in a social interaction between himself and the external regulators. This sense should be avoided or, at least, reduced to a minimum (Bernardini, 1999). However, there is another cause for concern: if the subject is silent for a long time, the verbalization obtained becomes useless because significant parts of the cognitive process may not be investigated and might change the actual information to some extent. In addition, emotional and motivational factors can also produce a cognitive process different from the one that would take place without thinking aloud. The researchers usually tried to sidestep this problem by reminding the subject to think aloud (Krahmer & Ummelen, 2004), but this "thinking aloud", as a method of eliciting data, is not the same as "thinking aloud" in the everyday sense, which entails something other than sitting people down next to tape recorder and asking them to talk (Jääskeläinen, 1999). Stated differently, the participants who were asked to think aloud, as part of a research method, will not talk to them selves *spontaneously* but instead, talk to themselves because they have been instructed to do so. Therefore, the presence of another person, as an external regulator, creates the problem of separating social speech from private speech (Fuson, 1979).

Subsequent research (Schraw, 1994; Schunk, 1986; Stright et al., 2001) described the good self-regulation learners as those who can recognize the importance of instructions, monitor their own progress and seek additional instruction when they have difficulty. Self-regulation inherently relies upon a multi-dimensional construct that has traditionally been difficult to operationalise (Boekaerts, 1996; Boekaerts & Corno, 2005). Because of this difficulty, many researchers have examined only limited aspects of SRL and have relied exclusively on self-reports to measure SRL. It is worth to question that how can self-report be used with children at an early age and why do not develop such a measurement that can be inherently used without distorting children's natural spontaneous to respond? To understand children's development more fully, a few studies (Sektnan, McClellanda, Acocka, & Morrisonb, 2010) have suggested that attention must be given to specific aspects of a child's environment that may influence the successful mastery of early academic skills. In particular, children's behavioral regulation (the ability to control, direct, and plan behavior) has been shown to be an important predictor of early academic achievement (McClelland et al., 2007). The literature, however, still lacks such a practical standalone learning environment that does not allow, or reduce at least, the external intervention before/after/during learning tasks.

1.2. Theoretical critique on the task feedback with young children

In the literature, many types of task feedback have been investigated by the researchers (John Hattie & Timperley, 2007). The most common types are Knowledge of performance (KP), e.g., "you solved 90% of the problems correctly", Knowledge of result/response (KR), i.e., "your answer is correct/incorrect", Knowledge of the correct response (KCR), i.e., provides the correct answer to the given task, Answer-until-correct (AUC), i.e., providing KR and offers the opportunity of further tries with the same task until the task is answered correctly, Multiple-try feedback (MTF) provides KR and offers the opportunity of a limited number of further tries with the same task, and Elaborated feedback (EF) provides additional information besides KR or KCR. However, the question of whether young children, especially at an early age, are able to assimilate or even to understand the meaning of these types of feedback remains challenged. Some studies (Gottfried, Fleming, & Gottfried, 1994) concluded that if a child, on one hand, completes a task simply to receive a grade and the grade is not what he thought it should be, then he will be disappointed and provide less effort in the future. On the other hand, a child who completes a task to satisfy his curiosity and receives an average grade will provide more effort in the future to quench his curiosity or master a skill. However, numerous studies have ranged from extremely positive, through no effect, to strong negative effects and the feedback sign (positive/negative) does not explain the large variance in the effects (Kluger & DeNisi, 1996).

2. The present study

In contrast with the Vygotskian and Piagetian views and unlike the previous work, the present study investigated the effect of the absence of the external regulators on children's use of speech (private/social), self-regulation, task performance, and satisfaction during learning tasks through an isolated, computer-based learning environment that did not allow any previous training or external intervention before/during/after learning tasks (to our knowledge, this subject has not been previously explored). Accordingly, the present study proposed a novel methodology through a computer-based learning environment and, hence, defined self-regulation as "the learners' ability to direct their verbalization process and, simultaneously, monitoring their learning process's goals" (cf. Agina & Kommers, 2008). The proposed methodology proposed three types of encouragement with *only* two sequences of instructional conditions, Verbal–Gesture–Silent (VGS) versus Silent–Gesture–Verbal (SGV) whereas the Knowledge of response (KR) feedback was applied in three different ways, verbal KR feedback with verbal encouragement during the verbal unit, visualization-representation of KR without verbal encouragement during the gesture unit, and no KR feedback without any encouragement

during the silent unit. The two conditions (VGS versus SGV) were investigated through the following research question and hypothesis:

- Do children do better, worst or the same on the VGS condition compared to the SGV condition?

Hypothesis: During learning tasks in an isolated computer-based learning environment, children who start with the VGS condition outperform children who start with the SGV condition in: (A) producing more private speech than social speech, (B) manifesting a higher degree of self-regulation, (C) showing a higher degree of task performance, and (D) gaining a higher degree of satisfaction. Importantly, the present study was only investigated the two instructional conditions (VGS versus SGV) due the fact that the other instructional sequences (GVS, SVG, GSV, VSG, etc.) are currently under construction and each as a separate study.

3. Material and methods

3.1. Participants

The participants were 40 children (*M*age = 5.4 years) from Al-Dahra' preschool, which is one of the public preschools at the center of Tripoli. The teachers distributed the children into two equivalent groups corresponding to the two instructional conditions (VGS/SGV). Each group involved 20 children (10 boys and 10 girls). All children spoke Libyan as their native language, which is a hybrid of Arabic and Italian and was also the language used by the stimulus material. The school medical records were revised for all the participants to mainly ensure that there is no sign for attention deficit hyperactivity disorder (ADHD) or similar challenges such as the autism spectrum disorders (ASD) or problems with hearing or vision.

3.2. The learning environment

The stimulus material was a computer-based edutainment program presented as an isolated, computer-based learning environment (i.e., it does not require the child to have previous training and simultaneously prevents the intervention of external regulators before/during/after learning tasks). It was specifically implemented for the present study to enable young children to talk and think while moving through the three different proposed stages of the computer encouragement cues (verbal/gesture/silent). In total, 21 tasks were selected among the developed tasks in close cooperation with various preschool teachers and based upon the children's daily activities in their classroom. The tasks were also evaluated by a number of children through a pilot study 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 *exactly* as the children experienced in their daily classroom activities (as an effort to *avoid* children to seek help from the external regulators to understand the structure of the tasks during the actual experiment and to enable the game to act as a standalone learning environment).

3.2.1. The game progression

The progression of the game was based on two conceptual perspectives. The teachers first selected the tasks based on Vygotsky's theory of the "zone of proximal development (ZPD)", which is "the difference between what children can achieve without help and what they can achieve with help" (Vygotsky, 1978) to classify each tasks as a simple or difficult. Second, they ordered the tasks based on what they called the "zone of children's motivation (ZCM)", which they defined as "the gap between self-motivated learning and the need to be motivated to learn" to classify each tasks as motivated or unmotivated task for the child to interact. Accordingly, some tasks were identified as requiring little self-motivation despite the fact that they were classified as complex tasks, and other tasks, despite being classified as simple, required the child to be more self-motivated to interact. To our knowledge, the ZCM has no theoretical background or even such a perspective in the literature. Thus, the ZCM had had to be mentioned since the tasks were programmed in the game *exactly* as the teachers identified and classified them. Therefore, the game, per se, had have to be implemented to exactly fit the children's classroom learning process as an effort to *avoid* the intervention of the external regulators. By other meaning, any change in the learning process that the children were usually followed in their classroom may lead them to seek help from the external regulator or to produce undesirable cognitive processes.

Because no previous training was offered, as an effort to avoid any external interaction before the experiment, the game 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 five minutes or until the child reacted (Fig. 1). If the child did not react within five minutes, he ended the experiment. An animated and musical introduction then prepared the child 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 child that the time allotted for the task had ended). After the child entered, the game 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 child's favorite color ("*touch your favorite color*") without mentioning the statement "*with your finger*" to ensure that the child was able to point to the correct item using his finger and to warn the child to pay attention to the task-related time allotment. The child had had to react to each task within a minute; otherwise, he ended the experiment. The game allowed the children 60 seconds to choose the task level and the same time (i.e., another 60 seconds) to answer. This is the regular time given by the teachers at the school to the children to act and react and the game followed the same behavior to avoid children to bother because of the time during learning tasks. Before each task during the actual experiment, the Princess asked the child to make a decision about the next task level (i.e., whether he preferred an easier or a more difficult level for the next task). Technically, the game introduced two boards at the middle of the screen (Fig. 2)

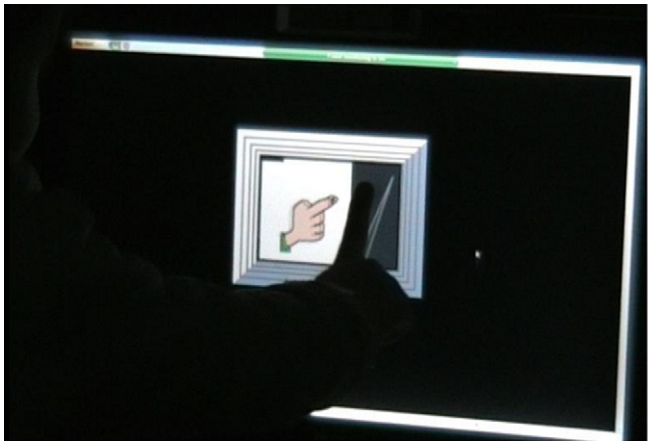

Fig. 1. Subjects start the game without previous training.

Fig. 2. Selecting the task level with one touch.

while the Princess asked the child to choose the complexity level of the next task: "*Touch the green board for the easier task or the yellow board for the more difficult task*".

3.3. The experimental design

The game involved three different instructional types/units of encouragement (verbal/gesture/silent). Each unit (verbal/gesture/silent) was involved the same seven tasks for both conditions (VGS/SGV). In each seven tasks there were one puzzle, two tasks of numbers matching (simple and complex), two tasks of social activates (simple and complex), and tow tasks of picture-arrangement (simple and complex). All the puzzles were simple but unmotivated for children to interact based on the teachers' ZCM perspective. As an effort to avoid the external intervention and undesirable cognitive processes during the performance, the tasks were introduced based on the children's classroom activities (i.e., each unit, verbal, gesture and silent, started with the numbering matching tasks followed by the picture-arrangement, social activities and ended by the puzzle).

3.3.1. The verbal instructional sequence

This sequence referred to the computer's verbal encouragement during learning tasks associated with verbal task KR feedback. Specifically, the computer, through Superman, verbally encouraged children every 10 s during each task to talk and think while they progressed through a set of encouragement cues. The time 10 s was based on the average the teachers encouraged their students in the classroom. Superman also verbally and clearly informed the child whether the task was correctly/incorrectly answered ("*Your answer is correct/incorrect*"). The pilot investigation, conducted prior to the present study, showed that children were unable to assimilate or even perfectly respond to the recommended reminder "*Keep talking*", (Ericsson & Simon, 1993) and the common question ("*What are you thinking?*"), which typically used with thinking aloud research. Accordingly, the teachers, who closely cooperated with the authors, developed "AMA-CUES" as an alternative set of encouragement that the computer used during learning tasks based on a random function through Superman to encourage children to think and talk while acting alone (see Appendix A).

3.3.2. The gesture instructional sequence

This sequence referred to the computer's visualization-representation of the task KR feedback *without* verbal encouragement during learning tasks and was represented by happy and unhappy faces for the correct and incorrect answers respectively. The happy and unhappy faces were very familiar to all children as the signs used by their teachers for good and "not good" achievements in the classroom. When the child answered correctly/incorrectly, a happy (Fig. 3) or unhappy (Fig. 4) face appeared in the middle of the screen for five seconds while the Princess and Superman followed that facial action.

3.3.3. The silent instructional sequence

In this sequence, the computer offered no reaction and presented the next task-level choice instantly after each task (i.e., no verbal encouragement or task KR feedback).

3.3.4. Measuring children's speech utterances

The children's private speech was differentiate and defined as any speech about the task, explanation/comments about the answer/question, or ongoing process (Winsler, Fernyhough, McClaren, & Way, 2005). However, only the short sentences (i.e., murmuring such as "*offfff*", "*aha*", "*wow*" and so on, whispers and inaudible lip movements) were also categorized as private speech utterances too. The children's social speech was simply defined as any speech that was not classified as private speech (i.e., the speech the child verbalized about the computer, game, environment, classroom, teachers, or any other speech was not classified as private speech). The utterances of both speech types were counted and tabulated (see examples in Appendix B).

3.3.5. Measuring children's self-regulation

According to the child's choice of a more simple/complex task level, the computer scored the degree of the child's manifested self-regulation after each task. Specifically, whatever the child decided to choose (simple/complex), the game introduced the tasks in the sequence of simple, complex, simple, complex and so on and applied the hypothesized relationship after each task. However, if the child did not make any decision within 60 s; the game presented *the same task* and labeled it as a mid-level (exactly as the teachers followed in the classroom). Stated differently, in the actual experiment children were received the same task regardless of their preference (simple/difficult), although they were kept unaware of this fact. According to this fact, the game applied the hypothesized relationship that was developed through a pilot investigation prior to this study with 103 children. The hypothesized relationship involved five criteria as the principles guide of measuring children's self-regulation that the computer used during learning tasks. For the sake of simplicity and clarity, the present study named those principles as "AMA-GUIDE" (see Appendix C).

3.3.6. Scoring task performance

The game automatically scored the task performance as correct/incorrect for each task and related the final judgment of the task precision to the choice of task complexity level that the child made before presenting the actual task (i.e., the score was related to the degree of the child's manifested self-regulation for the task itself). However, if the child did not answer during the task allotted time, the game considered that as incorrect answer (exactly as the teachers followed in the classroom). The present study named this system as "AMA-SCORE" (see Appendix D).

3.3.7. Measuring the children's satisfaction during the performance

Children under both conditions were given the opportunity to describe their feelings (*satisfaction*) through a friendly chat questionnaire with the Princess and Superman that involved eight simple questions. Superman started the questionnaire by informing the child that he and the Princess would like to chat with him about the game because he (the participant) showed a high degree of intelligence and could help to improve the game (regardless of

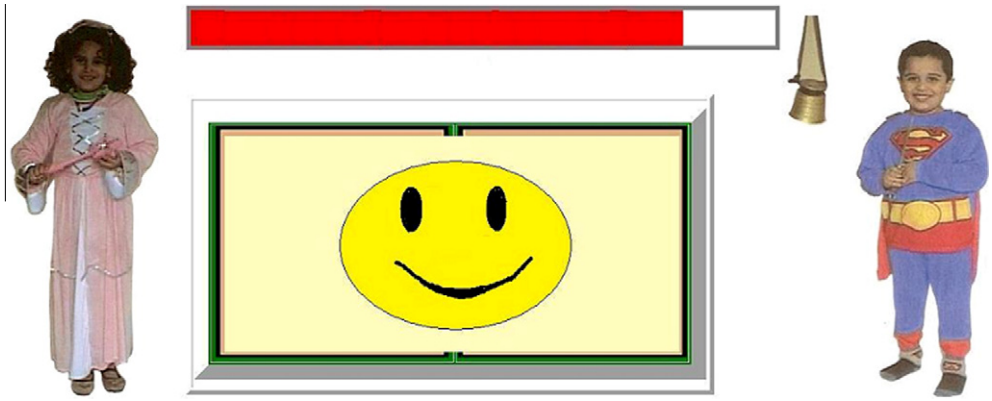

Fig. 3. The computer's visualization-representation of the KR feedback (the correct answer).

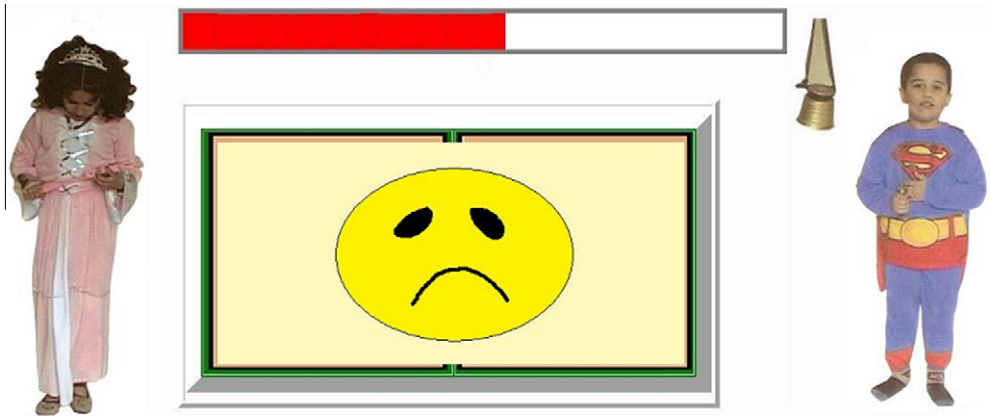

Fig. 4. The computer's visualization-representation of the KR feedback (the incorrect answer).

his actual achievement and as a motivation for the children to talk exactly as the teachers followed in the classroom). First, Superman asked the child whether he would like to chat with them by touching the correct (agree) or incorrect (disagree) sign in the middle of the screen (Fig. 5). If the child agreed, the Princess first told the child 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 child to touch the correct sign once again within two minutes, which was the allotment time for each question. If the child agreed to answer by touching the correct sign, Superman asked the series of questions. When the child either declined to chat or finished the questionnaire, the Princess moved the game to the reward session (Fig. 6), which was the last session. Each child was rewarded with a piece of chocolate (Kit-Kat/Mars), which were the favorites among the participants as their teachers mentioned. The Princess and Superman thanked the participant and informed him that he did a very nice job with high performance and told him that when the room light comes on, he will find the chosen chocolate with the teacher in the meeting room.

3.3.8. Data gathering

The game gathered data on factors such as the exact time the child started the game, the chosen task level, the actual task level,

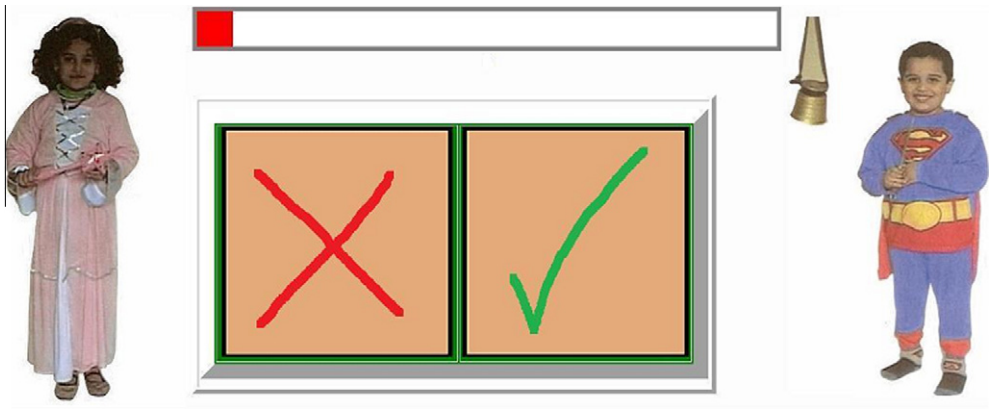

Fig. 5. The friendly chat questionnaire.

Fig. 6. The game's reward session (the last session).

the level response time in milliseconds, the task score based on "AMA-SCORE" and task precision response-time in milliseconds, and the degree of the manifested self-regulation based on the "AMA-GUIDE" for each child. All video data were gathered and reviewed to collect the utterances, the questionnaire was also reviewed for each child's answers, and finally, all the utterances and other data were tabulated.

3.4. Procedures

The school has a special experimental room ready for any experiment with children and their teachers. This room was located in a quiet corner and involved a child-sized chair, an external touch-screen (17-inch) used to avoid any possible coordination problems for the children connected to a laptop computer with two hidden portable video cameras. 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. An extra small microphone was connected to the second camera for better audio recording. Children were kept unaware of the cameras and the microphone to avoid a problem of splitting attention that could lead to undesirable cognitive processes. Each child attended a five-minute welcome session in the preschool's meeting room but did not receive training on how to use the game. Instead, children were made aware that the game required a smart player to complete the tasks and that they should follow the instructions given by the computer. They were also made aware that neither their teacher nor the experimenter would know the answers. All sessions were held in the morning at 9:30 AM to avoid differences due to fatigue. The actual experiment ran with two children of each group per day (first two VGS children and then two SGV children) and the entire experiment required ten days to accomplish.

4. Results

The initial research goal was to examine the effect of the external regulators' absence on young children's use of speech (private/social), manifested self-regulation, task performance, and satisfaction when they talk and think while acting alone. This was done by finding the differential effect between the two types of instructional conditions, Verbal–Gesture–Silent (VGS) versus Silent–Gesture–Verbal (SGV) in a laboratory condition without the influence of external interventions before/during/after learning tasks.

4.1. The overall performance (the research question)

The research question addressed had to do with the difference in overall performance between the two conditions in terms of better, worst or the same on the VGS condition compared to the SGV condition. The effect of the condition (VGS versus SGV) on the scores for task performance related to task level (simple/complex/mid-level) and task precision (correct/incorrect) was performed by ANOVA. The result revealed a significant condition effect, $F(2.37) = 25.64$, $p < .01$, $\eta^2 = .80$, indicating as expected that children under the VGS condition were outperforming the children in the SGV condition despite children in the SGV condition were faster in the responses during the learning tasks (Table 2).

4.2. The VGS condition produced more private speech than social speech (Hypothesis A)

Table 1 showed that the most significant differences between the two conditions concerning the intensity of both private and social speeches was during the verbal unit (23% of private speech with no utterances of social speech for the VGS condition and .08% of private speech with 16% of social speech for the SGV condition). In sum, children in the VGS condition were more speech productive (53%) than children in the SGV condition (47%) that confirmed the hypothesis. However, the Kappa scores indicated very good agreement between the two conditions ($\kappa > .95$) in speech productivity during the verbal unit (i.e., with verbal KR feedback and verbal encouragement during learning tasks), good agreement between the two conditions ($\kappa > .65$) during the gesture unit (i.e., with

Table 1
The effect of the VGS versus SGV on children's speech productivity, by condition.

Speech intensity	Verbal–gesture–silent condition ($n = 20$)			Silent–gesture–verbal condition ($n = 20$)		
	During verbal unit	During gesture unit	During silent unit	During silent unit	During gesture unit	During verbal unit
Private speech (61 utterances: 56%)	25 (23%)	11 (10%)	13 (12%)	3 (.02%)	No utterances	9 (1%)
Social speech (47 utterances: 44%)	No utterances	8 (.07%)	No utterances	12 (11%)	10 (.09%)	17 (16%)
Total (108 utterances)	25 (23%)	19 (18%)	13 (12%)	15 (14%)	10 (.09%)	26 (24%)
	57 utterances (53%)			51 utterances (47%)		

visualization-representation of KR feedback and no verbal encouragement during learning tasks), and very good agreement between the two conditions ($\kappa > .90$) during the silent unit (i.e., without KR feedback or verbal encouragement during learning tasks).

4.3. The VGS condition manifested a higher degree of self-regulation (Hypothesis B)

Children in both conditions manifested a higher degree of self-regulation *when but not related to* verbalizing private speech than social speech (Tables 3 and 4). However, despite children in both conditions manifested a higher degree of self-regulation during the verbal unit, the Kappa scores indicated poor agreement between the two conditions ($\kappa < .20$) in manifesting self-regulation during the same unit (i.e., poor agreement in verbal unit, poor agreement in gesture unit, and poor agreement in silent unit in manifesting self-regulation during learning tasks). In sum, children in the VGS condition manifested a higher degree of self-regulation than children in the SGV condition that confirmed the hypothesis.

4.4. The VGS condition showed a higher degree of task performance (Hypothesis C)

The ANOVA, after controlling the task precision, revealed no significant effect, $F(3.85) = 0.15$, $p > .05$, $\eta^2 = .04$, indicating as *not* expected that children in the VGS condition showed a higher degree of task performance than children in the SGV condition. An ANCOVA was performed with condition (boys versus girls) for each group to determine the effect of the gender (as a covariant variable) on children task performance whereas the quantitative explanatory variables were the children's task precision and children's age. The result revealed no significant condition effect for the VGS condition, $F(1.13) = 0.40$, $p > .05$, as no significant condition effect for the SGV condition, $F(3.21) = 0.05$, $p > .05$. The correlation between the children's task precision and applying the "AMA-GUIDE" in the VGS condition was ($r = .01$, *ns*) and in the SGV condition was ($r = .02$, *ns*) and the Kappa scores indicated poor agreement between the two conditions ($\kappa < .20$) in increasing task performance during the same unit (i.e., poor agreement in verbal unit, poor agreement in gesture unit, and poor agreement in silent unit).

4.5. The VGS condition showed a higher degree of satisfaction (Hypothesis D)

Children in both conditions (Table 5) showed the same degree of satisfaction when they acting alone and without external regulation or previous training, indicating as *not* expected that children who start with the VGS condition gained a higher degree of satisfaction than children who start with the SGV condition. Children at both groups showed no complain (100%) to use the game with no difficulties to select the task level (100%). Children were also agreed to use the game in future (100%) and to recommend this game either (100%). However, (15%) of children in the VGS condition and (10%) of children in the SGV condition were disliked the game where all children (100%) were disagreed about the presence of their teacher during the performance. Two children (5%) of the VGS condition started the game after the first minute of the game introduction where all the SGV children started the game at the first minute but no child was refused to continue the game until the last session.

5. Discussion

The present study investigated the effect of the external regulator's absence on young children's speech use, manifested self-regulation, task performance, and satisfaction during learning tasks through an isolated computer-based learning environment. Three different units (verbal, gesture, and silent) of encouragement were proposed for each instructional sequence and examined through two different instructional conditions, Verbal–Gesture–Silent (VGS) versus Silent–Gesture–Verbal (SGV). The Knowledge of response (KR) feedback was applied in three different ways, verbal KR feedback with verbal encouragement during the verbal unit, visualization-representation of KR without verbal encouragement during the gesture unit, and no KR feedback without any encouragement during the silent unit.

Table 2
The effect of the VGS versus SGV on children's responses in milliseconds, by condition.

Responses	Verbal–gesture–silent condition ($n = 20$)					Silent–gesture–verbal group ($n = 20$)				
	M	SD	Sum	Max	Min	M	SD	Sum	Max	Min
Task-level response time	7054	7016	2821999	36752	950	5153	3818	2056173	26325	950
Answer response time	11664	9866	4665623	85738	921	7442	6034	2969384	51977	1005

Table 3
The effect of the VGS condition on children's manifested high self-regulation.

The manifested SRL How often did the VGS children apply AMA-GUIDE during verbalizing private and social speech?	Verbal–gesture–silent condition ($n = 20$)		
	During verbal unit	During gesture unit	During silent unit
When verbalising private speech (198 times – 61%)	93 (47%)	58 (29%)	47 (24%)
When verbalising social speech (127 times – 39%)	33 (26%)	51 (40%)	43 (34%)
Total (325 times)	126 (39%)	109 (34%)	90 (27%)

Table 4
The effect of the SGV condition on children's manifested high self-regulation.

The manifested SRL How often did the SGV children apply AMA-GUIDE during verbalizing private and social speech?	Silent–gesture–verbal condition ($n = 20$)		
	During silent unit	During gesture unit	During verbal unit
When verbalising private speech (107 times – 59%)	17 (16%)	41 (38%)	49 (46%)
When verbalising social speech (75 times – 41%)	30 (40%)	19 (25%)	26 (35%)
Total (182 times)	47 (26%)	60 (33%)	75 (41%)

Table 5
The effect of media communication on children's satisfaction during learning tasks.

The friendly chat questionnaire	Children's responses			
	Agree		Disagree	
	VGS (n = 20)	SGV (n = 20)	VGS (n = 20)	SGV (n = 20)
(1) The game is easy to use	20 (100%)	20 (100%)	–	–
(2) It is easy to select the task level	20 (100%)	20 (100%)	–	–
(3) All tasks are difficult	5 (25%)	5 (25%)	15 (75%)	15 (75%)
(4) The task time is enough	18 (90%)	17 (85%)	2 (10%)	3 (15%)
(5) You will play this game once again	20 (100%)	20 (100%)	–	–
(6) You will recommend this game	20 (100%)	20 (100%)	–	–
(7) You like this game	17 (85%)	18 (90%)	3 (15%)	2 (10%)
(8) You want the teacher [name] to be with you	–	–	20 (100%)	20 (100%)

Note: VGS: verbal–gesture–silent group/SGV: silent–gesture–verbal group.

Overall, the results from this study show that children who start with the verbal encouragement followed by the gesture and silent encouragements outperform those children who start with the silent encouragement followed by the gesture and verbal encouragements. The effect can mainly be understood as producing a higher intensity of private speech than social speech with a higher degree of manifested self-regulation with slightly differences in task performance and satisfaction. The finding that both groups of children performer better during the verbal unit compared to when no encouragements were given during the silent or when were given as a visualization-encouragement during the gesture unit supports the previous studies (Lee, 1999; Winsler et al., 2007) only in terms of manifested self-regulation but not in task performance. Our investigation shows that when children start with the verbal condition, they are also continuing to talk to themselves even during the gesture and silent units. In contrast, when children start with the silent unit, they are spontaneously talking to themselves without previous encouragement to do so, which is clearly thinking aloud verbalization despite the low intensity. This finding emphasizes that private speech is not the same as thinking aloud, which confirms the previous work (Krahmer & Ummelen, 2004) and also clarifies what the previous work (Diaz & Berk, 1995) warns that there are likely conditions under which giving children instructions to use speech can hinder their natural performance (given the fact that the silent unit is the natural situation for students during the performance).

Children in the present study show almost the same level of satisfaction to simultaneously talk and think while acting alone and provide evidence that they can engage with the isolated, computer-based learning environment without the need of the external intervention or any previous training. This finding emphasizes that the methodology used in the present study eliminates any human–human external intervention before/during/after the performance, which is in contrast with all the previous methodologies (Fernyhough & Fradley, 2005; Tang et al., 2007; Winsler et al., 2007) that supports instructing or guiding the participants before/during/after the performance as human–human interaction. While this result, on one hand, does not confirm the Vygotsky's view that self-regulation is a result of external regulation, it is supporting (or neutralizing, at best), on the other hand, Piaget's view that external intervention hinders the self-regulation development. From a practical point of view, the present study can be seen as a practical experiment of the previous work (McClelland et al., 2007; Sektnan et al., 2010) that have suggested that attention must be given to specific aspects of a child's environment that may influence the successful mastery of early academic skills. The participants should not feel any kind of external intervention that leads to social interaction that, in turn, makes the elicitation to think aloud leads to social rather than private communication and hence, causes cognitive overload. In other words, the human–human external intervention during the performance distorts the students' cognitive processes and private speech productivity where children should be indirectly and without splitting their attention encouraged to talk and think while acting alone during learning tasks. The methodology of the present study has solved that problem and, thus, it recommends the use of the environments that act as a standalone learning systems. This recommendation leads the future work to consider the importance of investigating the thinking aloud protocols with young children when they acting alone.

Although, the proposed methodology of the present study uses the "AMA-GUIDE" and "AMA-SCORE" as new measurements of self-regulation and task performance respectively, both measurements need to be revisiting. First, the game needs to be updated to measure the extent that each child applies each principle of the "AMA-GUIDE" during the performance, which is very sensitive factor in terms of the effect of gender on overall performance and on task performance either. Second, the "AMA-SCORE" has to be *definitely* revisited and extended to cover all the possibilities that the game score them by zero whenever it is inapplicable in which it is currently under empirical investigation aims to develop more cohesive and reliable measurement with more scores. Despite, the fact that some of the findings of the present study deviate from previous studies, it is important to realize that, some of these trends should be taken cautiously because of the small sample size involved. This limitation will be taken into account in future work (mainly, to elaborate on these findings) and to investigate the other instructional sequences (GVS, SVG, GSV, VSG, etc). Therefore, the effect of each instructional order on task-level and task precision and the effect of the task type on children's speech use, manifested self-regulation and task performance should also be investigated.

6. Conclusion

The main conclusion of the present study is that the future research should take into account that young children are able to talk and think while acting *alone* and without any external intervention (before/during/after) learning tasks in which elicitation private speech from social speech will be more obvious and, therefore, the manifested self-regulation can be definitely increased without the need of the external intervention. According to that, distinguishing children's speech (private/social) from their actual thinking aloud will be easier in which the future research should take the use of the standalone learning environments into account and consideration. Second, the present study concludes that children's speech use (private/social) and manifested self-regulation are highly affected by the type of encouragement used during the performance but neither task performance nor children's satisfaction will be highly affected. Third, promoting children's self-regulation will be higher *when but not related to* verbalizing private

speech than social speech. Accordingly, teachers should not be worried about their students' speech use in the classroom as they should pay attention to the educational tools the children use during learning tasks. In sum, the use of the computer as a standalone learning environment to study young children's behavior has to be taken into account and the novel methodology used in the present study should be considered as a key that still needs more deeply investigation in all terms.

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Appendix A. "AMA-CUES" for children's verbal encouragement by the computer

The original utterance	English translation
(Exactly as verbalized by Superman during the performance. The language is a hybrid of Libyan and Italian and written by Arabic letters)	(The translation is based on the exact meaning but not on the word-to-word translation. So it can be presented in other words and context. However, the most important thing is the meaning of the original encouragement cues that should be clear in English)
The alternatives of the common question "What are you thinking?"	
اني نسمع... اني نسمع...وين الاجابة؟	I am listing, I am listing. Where is the answer?
كانك فهمت السؤال، مانا وين الاجابة؟	If you understand the questions, then what the answer is?
انت ساكت، هل في حاجة صعبة؟	You are silent, is there anything difficult?
The alternatives of the recommender reminder "Keep Talking"	
واضح ان السؤال ساهل، امماانا حتى الاجابة سهلة	Obviously, the task is very easy; then the answer is easy too
انت تعرف الاجابة. قولها	You know the answer, say it
تبي تقول اي حاجة عالاجابة	Anything you want to say about the answer

Appendix B. Examples of utternaces

The original utterance	English translation
(Exactly as verbalized by children during the performance. The language is a hybrid of Libyan and Italian but not pure Arabic and written by Arabic letters)	(The translation is based on the exact meaning but not on the word-to-word translation. During the stage of Data Gathering, the original utterances were used but not the translation)
Private speech	
ما فيش حاجة صعبة و الاجابة سهلة.	There is nothing difficult and the answer is easy
أوكان إنديرالاجابة بلعاني خطأ شن بصير.	If I intentionally make the answer incorrectly, what will happen?
أحاول فهم هذا السؤال.	I am trying to understand this question.
لمما نعرف الاجابة تو انمسها بصبعي... مازال معرفتهاش.	When I get the answer I will touch it by my finger... I do not know it yet
باين عليها اجابتي هذي مش صح.	Seems my current answer is incorrect.
أووف علينا عاد... قوللي انت علاش غلط.	OFFF... What is wrong with us, you tell me why it is wrong?
ابيه... ديمة غلط.	EY-YAH... always incorrect
مأ تقولليش الاجابة هذي غلط.	Do not tell me this answer is incorrect
الاجابة هي هذه.	This is the answer
Social speech	
لبسة سوبرمان امنين جابها؟	How superman got his clothes?
علاش السوبرمان في جنبه في جرس؟	Why there is a ball nearest to superman?
انقول لي بابا ديرننا اللعبة هذي في الحوش.	Tell dad to get this game to our home
علاش الابلة ما تجيبيننا اسئلة الكمبيوتر؟	Why the teacher does not introduce us the questions by computer?
المفروض الاميرة توقف في الجهة الثانية.	Suppose the princess stands at the other side
مافيش ماوس.	There is no mouse

Appendix C. "AMA-GUIDE" for measuring self-regulation learning

AMA-GUIDE-(1)
A child chooses a simple task after he could not complete the previous task because of time

AMA-GUIDE-(2)
A child chooses a complex task after he completed the previous task correctly

AMA-GUIDE-(3)
A child decides to continue with the complex task after he completed the previous task correctly

AMA-GUIDE-(4)
A child decides to continue with the simple tasks after he completed the previous task incorrectly

AMA-GUIDE-(5)
Any other decision the child made is classified as inadequate self-regulation

Appendix D. "AMA-SCORE" for scoring task performance with SRL

Score 2

(For the correct answer at the complex level and incorrect answer at the simple level IF AND ONLY IF the task level choice was a complex level and the previous answer was correct)

Why?

Because the child already regulated himself to face a complex task based on the correct answer of the previous task, which is naturally requiring a high degree of self-regulation to make this decision, the incorrect answer of the simple task is ineffective on the child's manifested self-regulation. Thus, the game scored two points even if the current task is simple and the child's answer is incorrect. Otherwise, the game scored zero point

Score 1

(For the mid-level IF AND ONLY IF the child answers the current task correctly)

Why?

Because of the probability that a child may intentionally deselect the task level to examine what the game is going to present if he did not make a choice, which is a degree of self-regulation that hardly to be known during the performance (i.e., it is impossible to know whether the child was really followed that behavior or not). Thus, the game scored one point if the child's answer is correct regardless the task actual level (simple/complex). Otherwise, the game scored zero point

Reminder: The mid-level means that a child did not make a choice about the task level (more simple/difficult)

Score 0

For the correct answer at the simple level and incorrect answer at the complex level IF AND ONLY IF the task level choice was a simple-level and regardless the previous task precision)

Why?

Because the simple task can be easily answered even with a low degree of self-regulation as it is a natural response to answer the complex task incorrectly even with a high degree of self-regulation. Thus, the game scored zero point

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