EFFECT OF IPAD USE ON SAUDI CHILDREN'S CLASSIFICATION OF AND JUSTIFICATIONS REGARDING LIVING THINGS: A SOCIO-CULTURAL LEARNING PERSPECTIVE

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Abstract. *This semi-empirical research utilises a structured interview interview approach to explore Saudi children's ideas about living things and to examine the effects of iPad use based on a socio-cultural perspective involving group work and discussion. The sample comprised 40 grade 1 children; 20 were empirically taught using iPads according to a socio-cultural perspective, and 20 were taught in the traditional teaching style. The structured interview approach in which children classified 21 cards (7 animals, 7 plants, and 7 artefacts) as living or nonliving things. The results indicated that children had varied misconceptions regarding the classification of and justifications about living things, especially regarding plants. The use of iPads according to a socio-cultural perspective had a positive effect on children's knowledge development. Children in the iPad group performed better in categorising different types of animals and plants and in justifying their views.*

Keywords: living things, iPad, primary school students, biological justifications, socio-cultural perspective.

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Introduction

The understanding of children's ideas tends to influence what students gain from instruction and plays a crucial role in providing data for people who are interested in developing the curriculum, textbooks and teachers. While the critical practice of classification is implemented in a number of scientific arenas, it is recognised as being particularly important in the biological sciences, for the determination of living and nonliving things and for the taxonomy of living things (So & Ching, 2015).

In biology, the key concept in classification is the differentiation of living and nonliving things. However, there are gaps in the literature in regards to the particular area of children's ability to classify plants and animals as living things. In fact, most children's perceptions and knowledge of plants and animals are poor, with their understanding only extending to a few species. Furthermore, very little is known about the knowledge of early-grade-school children pertaining to plants and animals in the context of Saudi Arabia. As very few studies are available on first-grade (6-year-old) school children's knowledge of living things in the Saudi Arabian context, it is reasonable to infer that children in this location have not been extensively examined in terms of their ability to justify their classifications of living or nonliving things. Earlier work has indicated that is only by age 10 or 11 that these children develop an understanding that plants reproduce and grow, and that such properties are criteria for living organisms (Piaget, 1929).

Young children enter formal education with their own prior understanding of the world, scientific concepts and knowledge, all of which affect their school learning of science (Driver et al., 1985; Osborne & Freyburg, 1985). Thus, it is necessary for teachers to be aware of children's misconceptions when planning their lessons, although this is not always done due to a lack of time; rather, teachers tend to make assumptions regarding a base level of students' knowledge.

The present research adopted the view that children's knowledge of living things is usually developed through cultural tools, examples of which include language and iPads. It is also held that learning is far more effective when learning experiences are practical. Moreover, early scientific experi-

ences should be child-centred, enjoyable learning experiences that not only consider a child's knowledge, but also address any misconceptions a child might hold. Accordingly, various teaching styles, approaches and resources should be considered to ensure that fun and accessibility are achievable in learning how to classify living things.

Children's Learning about Living Things

Stavy and Wax (1989) completed a systematic analysis on whether 6 to 15-year-olds in Israel considered plants and animals to be living entities. In the research (Stavy & Wax, 1989), students were presented with pictures of animals, inanimate objects and plants, and then asked to classify them as living or nonliving. They were also asked whether or not the pictured items possessed a number of different characteristics, including the ability to breathe, grow, feed and reproduce. The findings showed that even among grade 6 children (aged 11–12 years), more than 40% held the view that plants were not living things. Some of the children in that research classified plants as nonliving, while others labelled them as neither living nor nonliving.

Later research has investigated which species children are familiar with, and has examined the effects of place of residence and preliminary contact with species (Patrick & Tunnicliffe, 2011; Ugulu & Ayden, 2011; Campos et al., 2012). For example, Patrick and Tunnicliffe (2011) asked nine children aged 4, 6, 8 and 10 years old, living in England and in the United States, to freely list plants and animals. The children were also asked to label the animals they knew that were found in specific habitats or that had particular characteristics. The findings showed that the younger children recognised the animals that were present in their everyday lives, with the 8-year-olds being generally able to label and identify the majority of animals. This research emphasised that children interact with their surrounding environment to different degrees, and that rich experiences with the environment significantly affect children's overall knowledge of plants and animals. Campos et al. (2012) analysed how students' familiarity and initial contact with species relate to socio-demographic variables in the context of an Argentinian arid environment.

Campos et al. (2012) also noted that students can often list more plant than animal taxa. This is a valuable finding, given that prior research has concluded that students know more about animals than plants; for example, Patrick and Tunnicliffe (2011) have reported that students more commonly refer to animals than plants. Based on their results, Campos et al. (2012) concluded that it is necessary to enhance students' knowledge of native species, through the use of informational sources close to nature, without disregarding what students know about exotic species, which they seemed to be more familiar everyday life. Interestingly, Ugulu and Ayden (2011) reported that a large majority of Turkish students (83%) had learned about medicinal plants from their families through home-based interactions.

The aforementioned research provides insight into what children know about plants, as well as the challenges some experience in recognising plants as living things (Tao, 2016). Other research has examined how and when children categorise plants as living organisms, and what experiences trigger children's ability to recognise plans as being alive. For example, Brulé et al. (2014) examined how a sample of 60 children explained plants, and how their perceptions of plants changed during the preschool ages of 5, 6 and 7. The results showed that children's justifications of plants as living or nonliving could be categorised into four types related to appearance, biology, function and motion.

Tao (2016) investigated how preschool children in China categorise plants into nonliving or living. The sample comprised 40 females and 50 males between 4–6 years old, from three different public kindergartens in Jiangsu Province in Eastern China. Interviews were carried out in line with the scholars' prior research on elementary school children's conceptual understanding of living and nonliving things (Tao et al., 2012). The findings indicated that children's justification of plants as living things changed between the ages of 4 and 6. Furthermore, the way in which children's justifications developed may have been affected by learning advances in biology. It was notable that 4-year-olds tended to provide perceptual justifications, whereas 5-year-olds were much more likely than 4-year-olds (or 6-year-olds) to utilise motion cues in their justifications.

Shifts in Learning and Teaching

The modern world is characterised by significant and rapidly implemented changes stemming from developments in science, technology and information technology (IT) (Alsalkhi, 2013). Accordingly, it has become important for educational institutions across the globe to acknowledge and pay attention to recent educational

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and teaching methods, so as to ensure that any issues stemming from changes can be addressed (Alsalkhi, 2013). Such changes include the emergence of different methods and patterns of teaching (ibid). When accepting and adopting new technology in the classroom (Barki & Benbasat, 2007), the overall interest and competence of the faculty is a critical consideration that can influence the acceptance and subsequent success of the technology. As a result of the presently happening shift in terms of interactive learning, Barkiand Benbasat (2007) suggest that teachers should utilise novel E-Learning tech; however, despite this, the faculty of science education within the Kingdom of Saudi Arabia (KSA) persists in utilising more traditional materials for teaching such topics (e.g., blackboards; workbooks). When comparing KSA to other countries, it is evident that the schooling system here needs considerable improvement and focus—particularly in terms of the curriculum, approaches to teaching, and methods of training teachers (Sywelem & Witte, 2013). After acknowledging the above, a vast number of Saudi teaching facilities have, indeed, started adopting technology in their teaching methods in order to guarantee the fact that their teaching methods are modern and advanced—and yet despite this new effort toward a more technology-based way of teaching, a great number of teachers still, according to Alsharari (2010, p. 50), '…lack sufficient preparation regarding the use of the computer and the Internet.'

Classroom iPad Use

Classroom iPad usage is one of the main technologies currently being implemented into educational settings. As iPad use in the classroom is a relatively new method, it difficult to establish whether or not such use provides learning benefits. Research focusing on the use of iPads in traditional academic environments is insufficient (Wilson et al., 2013). Notably, there is actually very minimalbasis for the belief that infants learn quicker, better, and easier with the aid of such technological phenomena (Hu, 2011); an example of this is that of iPads, which have been noted for being the perfect systems for capturing the attention of infants, but not particularly for engaging them in long-term learning. However, Karsenti and Fievez (2013) consider that although iPad programmes have not been successful in reaching their full potential, this is because iPad integration is not yet complete, making the benefits to students not yet identifiable. Benefits of classroom iPad use may include continuous access to communication and information, a greater degree of interaction among students and between students and teachers, higher levels of motivation, greater quality in the presentation of work, improved creativity, and a wealth of resources and learning materials that can be utilised by students and teachers (ibid). The implementation and utilisation of iPads in and beyond the classroom is thought to facilitate student interaction in ways that would not otherwise be possible (Heinrich, 2012). In essence, iPads provide support for social learning and networking, and can be used alongside other applications and tailored to fit students' needs; in this way, they facilitate classroom learning and provide opportunities for creative projects, analysis and reflection (Ainsa, 2013).

Crichton et al. (2011) has researched the advantages in learning performance provided by iPad use in the academic arena, with a focus on K–12 schools. The aim of their work was to measure the effects of iPad use on students' motivation to learn and overall interaction. They also focused on teacher involvement by measuring the effects of this technology on faculty performance. Crichton et al. found that iPads were generally accepted and utilised, with most of the studied elementary and junior high school students making use of the device. Importantly, enthusiasm was found to be high among both students and teachers, with both groups seeking to identify and make use of educational applications.

Kiger et al. (2012) conducted research on grade 3 students at an elementary school in the Midwestern United States by involving the students in a nine-week mobile learning intervention (MLI). The students were divided into two groups, with two classrooms utilising Everyday Math and daily practice with flashcards, among other resources, to learn multiplication skills. Another two classrooms used Everyday Math alongside iPad-compatible web applications for daily practice. Following the completion of a test, the iPad group was found to perform better when compared with the group utilising more traditional methods. Thus, Kiger et al. (2012) suggested that in-class mobile learning can foster and sustain productive student-teacher learning interactions.

This is worth noting when considering iPads were put forward to help teachers enhance their own grasps of given practices and conceptions (Wilson et al., 2013); indeed, the findings of this research suggested teachers acknowledged how valuable possessing such materials (e.g., a camera; learning apps; presentation technology; Internet) is, the majority of the subjects additionally stating that the visual aspects of such technology aided in students' understandings of ideas that are slightly more complex in nature.

So and Ching (2015) carried out a quasi-experimental investigation by examining student learning of ani-

mal classification with Internet resources. The sample comprised two grade 6 classes of differing ability, both working in resource-based e-learning environments. During the application phase, students were asked to view video clips of penguins and dolphins; a subsequent discussion ensued, in which the students were asked to categorise the animals and provide justifications for their choice. All the students completed an online form to provide justification for their categorisation. The findings showed that the students did not enjoy learning with the use of Internet resources; nevertheless, a good understanding of animal classification was achieved in terms of taxonomic groups, and students were able to provide various examples of animals and characteristics for each of the categories.

Rafiki (2015) investigated iPad curriculum integration in grade 10 teaching and attempted to establish how the use of iPads among learners from different economic and social backgrounds could help to encourage both teaching and education in the life sciences. The results demonstrated that iPad use contributed to the transformation of positive education and teaching trends in school. Moreover, it was found that education independence and skills improvement were achieved through the use of iPads. As Rafiki's work highlights iPads as valuable in the classroom, it therefore emphasises the need for teacher training in this regard. Using a case study, Tay (2016) examined the effects of iPad use on both learning and teaching. A secondary school girl was the focus of the research. It was found that learners perceived there to be greater collaboration as a result of online connectivity and lesson design, with students being able to tap into a network of peers.

Science Education in the Saudi Context

Various countries across the globe are making changes to their education curricula (Ha et al., 2008), including the Gulf Arab states. A new Math and Science curriculum has been presented by the Saudi Ministry of Education, which has been applied across the KSA. In essence, this curriculum centres on the translation of science textbooks provided by the American publishing company McGraw-Hill. Obeikan Education has an agreement with McGraw-Hill that allows Obeikan Education to translate, localise and sell McGraw-Hill Math and Sciences curricula, grades K–12, to Ministries of Education across the Arabic Region (Obeikan, 2012, cited by Alghamdi & Al-Salouli, 2013). It is notable that the new science curriculum emphasises learning and teaching patterns, as well as underpinning aims and goals, to implement a learner-focused stance within inquiry-based instruction (Alghamdi, 2012). There has been much concern in relation to the implementation of this curriculum; opponents of the new curriculum argue that teachers should continue to implement more conventional teaching styles, with little change (Almazroa et al., 2013).

According to Al-Sadaawi (2007), teaching within KSA is mostly conducted on the grounds of approaches with teachers at the forefront of the process, factors such as inquiry, the growth of critical thinking skills, and the growth of problem-solving skills being neglected, instead prioritising things like memory skills; this unsuitable prioritisation leads to a decreasing of creative thinking within Saudi Arabian schools—a skill that urges debate, allows for the discussion of concepts and ideas, incites abstract thinking, encourages healthy competition, and leads to the growth of creative skills. This slow decrease of such pivotal skills is mostly as a result of the teachers themselves and their selected teaching methods, thus causing the Saudi Arabian education system to deteriorate and become less competent and resourceful; because of this, Saudi Arabia has taken action in recent years, focusing a large percentage of its finances on the education system via the endowment of assistance for schooling enhancement schemes and the development of a unique group of people for teachers. Saying this, the tangible results of these efforts still remain to be very low in proportion to what kind of results would have been anticipated considering the funds put into such efforts. Educational output results in the KSA are thus much lower than the effort required to invest in the education sector. As a result of the influence of traditional teaching, the KSA was ranked 93rd out of 129 countries by the United Nations' Educational, Scientific and Cultural Organization (UNESCO's 2008 index), which evaluates educational quality.

An analysis revealed no easily identifiable development or improvement in the country's standards of education over the previous four years. Over the last 20 years, educators have warned that the use of traditional methods is a key source of the problem behind the dysfunctional—and, in the view of some, obsolete—educational system in use in the KSA (Relan & Gillani, 1997). Traditional instruction has been explained by Relan and Gillani (1997) as 'teacher talk' in which instruction is common across the entire class, with individual and small group instruction being less common. In this method, the teacher usually dictates how class time is spent, with textbooks serving as the key guidance in curricular and instructional decision-making.

Cognitive Perspective and Socio-cultural Perspective

Current learning theories in the field of science education implement two different methods: the individual and socio-cultural accounts (Leach & Scott, 2003). When adopting an individual account of learning, the most valuable element is the development of the learning process in the child. Cognitive process underpins the constructivist approach. Carey (1985) claims that learning about living things requires radical conceptual changes that enable wholesale conceptual restructuring. A theory of conceptual change was developed by Strike and Posner (1985, cited by Lelliott, 2007, p. 45), which indicates 'how learners transform their conceptions during the process of learning, firstly by Piaget's assimilation, where a major conceptual revision is not required, and accommodation' in which children replace or reorganise their central concepts. Including the obtaining and reshuffling of scientific knowledge (more specifically, that of biology) for those aged between 4 and 10 years old, a naïve psychology births a naïve biology via a procedure equal to theory change's needed rearrangement.

In the socio-cultural learning account, which takes place in the social arena, learning may be seen to occur when an adult or other person provides direction; this could be a teacher, a peer or a parent. The relations involved are commonly referred to as the zone of proximal development (ZPD; Cobb, 1994). The accumulation of information and facts, in addition to other specific key inferences, provides a fundamental driving factor in the development of a naıve biology (Keil, 1992). This account suggests that children develop a better understanding of correct scientific conceptions when they are given cultural information.

The socio-cultural view provides reinforcement for socio-historical accounts of cognitive development (Vygotsky, 1978), in which children are considered to be novices whose development can be achieved through interactions with others and through the application of relevant cultural tools. In the present day, such cultural tools include the iPad. As highlighted by Keil (1992), learning information and facts about the biological world is fundamental to children's development, as this information allows children to distinguish between people and other animals, plants and nonliving things. This research implies that very young children may be able to differentiate between the ontological groups of nonliving and living things, if given adequate information and facts. Moreover, from an educational standpoint, learning experiences can provide further development in biological theory.

It has been noted by the USA National Science Standards (National Research Council, 1996) that children aged 5–10 should be able to identify organisms and outline their characteristics, habitats and life cycles. A greater degree of depth in this regard is provided by England's National Curriculum, which states that children should be able to draw a link between life processes and organisms within the local environment, and recognise characteristics of the differences and similarities between organisms. They should also be able to categorise organisms in line with their characteristics, identify organisms in their local environment and care for the local environment (England National Curriculum, 2011). In the KSA, biology is recognised as a pivotal element of the curriculum across all grade levels, and this subject is included as part of the general sciences (Aldahmash & Alshaya, 2012).

In grade 1, Saudi science textbooks detail classification in terms of the differences between living and nonliving things. At this point in their education, children are also taught about animals and plants, and their general characteristics. Such a science curriculum requires children to have an understanding of organisms and their differentiating characteristics, including their habitats. When children are able to consistently recognise life (as biologists define it), they are in a suitable cognitive position to develop new concepts and beliefs that align with core biological theory (Venville, 2004). Thus, it is unsurprising that most early education science curricula include learning about living things, and that this learning is then built upon in elementary and secondary school (ibid).

Problem of Research

The present research emphasisesd children's understanding and knowledge of the classification of living things as developed through the use of cultural instruments, including psychological instruments such as language and physical instruments such as iPads. The use of both psychological and physical cultural instruments occurs on the *interpsychological plane* (i.e. between children), and precedes the potential internalisation of learning, which occurs on the *intrapsychological plane* (i.e. within the individual) (Scott, 1998).

Even in late primary school, a significant number of students lack an understanding of the concept of living that corresponds with biological theory. Given the need for children to be cognitively prepared for biological

education at all levels, effective teaching on the concept of living things at a very early stage of learning cannot be overemphasized.

Teachers are believed to provide mediation between scientific knowledge and learners, in order to assist learners in making personal sense of how knowledge claims should be both created and verified (Driver et al., 1994, p. 6). Moreover, these scholars note that science learning involves 'becoming socialised… into the practices of the scientific community with its particular purposes, ways of seeing, and ways of supporting its knowledge claims' (p. 8).

Accordingly, children's construction of meaning is performed individually through the evaluation and re-evaluation of present knowledge, in addition to direct participation and interaction in the social construction of new knowledge (Driver et al., 1994, p. 7). From this perspective, knowledge is 'based in feeling, consisting in the skills, sensitivities and orientations that have developed through long experience of conducting one's life in a particular environment' (Ingold, 2000, p. 25) instead of 'a formal, authorised kind [of knowledge], transmissible in context outside those of its practical application' (ibid).

Internalisation is recognised as a process whereby children create and are able to utilise cultural tools within the social arena in line with their ability to make sense of what is communicated. This process is centred on the sense-making ability of the individual, and is not equivalent to a simple transfer of information. In contrast, conceptual change is not recognised as an individual process, but rather stems from a combination of the learner, tools and interactions between individuals.

Oladunjoye (2013) explained that because there is a link between non-human materials and humans, teachers and children are required to work together within a pedagogical environment. Expanding on this point, Oladunjoye stated that both human factors (e.g. culture, discourse, human social interaction and language) and non-human factors are fundamental in knowledge construction.

For understanding the coupling of activity and cognition, Lim (2002) provided a number of conceptual tools that can be utilised in different situations, and describes higher mental function as occurring on two different planes: the social plane followed by the psychological plane. 'It is recognised between individuals as an interpsychological category and then within the individual child (learner) as an intrapsychological category' (p. 413). An iPad may be considered as this kind of tool or instrument, since it fills a number of voids between intrapsychological and interpsychological groups. Importantly, computer devices may be seen as a form of mediation that enables and thereby influences learning.

High-quality photographs of a great diversity of plants and animals can easily be found on the Internet for free. If carefully selected, these photographs can be excellent materials for teaching children about different plants and animals (So & Ching, 2015). Similarly, videos – a medium that learners are very comfortable with – can provide clarity and explicitness about movement, context and other features that cannot be described using words or still pictures alone (ibid). Furthermore, videos can facilitate students' cognitive processing (ibid). Thus, photos and videos complement each other and become powerful learning materials that can enable children to learn about the classification of living things.

Research Focus

This research explored Saudi children's ideas about living things and their justification of their ideas. It also explored the effects of iPad use based on the socio-cultural perspective (i.e. involving group work and discussion) on grade 1 students learning about the classification of living things. The research questions were as follows:

RQ1: What different conceptions do first-grade children in Saudi Arabia have about living things?

RQ2: What kinds of justification do first-grade children provide regarding their classification of living things?

RQ3: From a socio-cultural perspective, how do iPad use and the teaching methods aligned with such use affect how children learn to categorise living things?

RQ4: From a socio-cultural perspective, how do iPad use and the teaching methods aligned with such use affect how children justify their categorisation of living things?

Research Methodology

General Background

The present research was semi-empirical in nature, and took a socio-cultural standpoint. Utilising a structured interview interview approach, it explored the effects of iPad use on how grade 1 students in the KSA learn about living things within science education. In particular, this research aimed to explore the effect of using an iPad on Saudi children's classification of living things and their justification of their classifications. This research is conducted in Aljouf City where children and schools have been selected—is a typical city, and therefore shares very similar cultural features with other cities in Saudi Arabia; this means that choosing any region would not be expected to affect the representativeness of the sample. Notably, this occurred in the second term of 2018.

Sample

The sample comprised 40 grade 1 children (approximately 6 years old) from two different primary schools in the north of the KSA. An experimental group of 20 students was taught by using iPads in line with the socio-cultural perspective, which involved group work and discussion. A control group of another 20 students was taught by the conventional method, which in the Saudi context refers to a traditional style of teaching.

Grade 1 students were used as the sample because the classification of living and nonliving things is taught at this grade level in Saudi science textbooks. Furthermore, this particular age has been recognised as pivotal in children's development of plant knowledge (Inagaki & Hatano, 1996; Brulé et al., 2014; Tao, 2016).

Instrument and Procedures

The 40 children in the sample were interviewed individually in a quiet room located in their school; this took up to 30 min per child. A structured interview approach was applied in which each child was given the task of separating picture cards into the categories of 'living things' and 'nonliving things'. Each child was given 21 cards to categorise, comprising seven animals (living things), seven plants (living things) and seven artefacts (nonliving things). The cards were adapted from the research of Brulé et al. (2014). After they categorised the cards, the children were questioned on their choices and asked to justify their choices.

Teaching by iPad in Line with the Socio-cultural Perspective

In Saudi grade 1 science textbooks, classification is taught in the first semester (s) of the year. Accordingly, the behavioural objectives of each lesson were identified and shaped by the researcher to ensure their suitability for the learning situation. It is no surprise that Saudi teachers frequently find it a challenging task to deliver sufficient aid and direction for all students equally via ZPD and guided rediscovery when considering the fact that Saudi classroom setups usually consist of an unbalanced ratio of a large number of students and just one teacher; as explored by Mercer (2000), when considering the specific infant's level of development at a certain point in time, this can be perceived as a fundamentally constant idea. From this, we can see that it was of high importance to form an educative atmosphere in which the infants were an integral part, forming a vigorous development procedure via communication (Staarman& Mercer, 2010).

Through the method of sorting the students into groups and implementing some basic rules (listed below) to aid the education of the students in terms of how they should communicate with one another whilst working in such groups, this above requirement was fulfilled, the students being finally able to communicate their thoughts, ideas, and varying levels of understanding of the topic being taught. Through this light form of discipline, infants are able to communicate and learn effectively (Lambirth, 2009) whilst also being reminded of the set rules throughout the duration of the task.

- Think about everybody's ideas and responses carefully.
- Give everybody the chance to communicate their ideas.
- Ask each person in your group what and why they think what they do.
- Give each person in your group enough time to respond to any questions you ask them.

- Maintain eye contact and listen to each person in your group when they are speaking.
- Reach a unanimous decision concerning each person's job in your group during the task.

Data Analysis

When analysing the interviews, the number of correct answers given by the children in each group were inputted into a frequency table. In order to quantify the justifications the children gave regarding their categorisation choices, tables listing prototype relevant categorisation reasons were provided. The justifications given in the interviews were coded according to theme, as outlined in other works. To establish the effects of iPad utilisation within the experimental group in comparison with the control group, the *t*-test in SPSS (Version 20.0) was used to differentiate between the two groups.

Ethics, Validity and Reliability Analyses

The ethics of this entire process were, of course, considered and adhered to: the parents of each of the students were involved in the investigation and communicated with openly about what it would entail, official parental consent documents also having to be signed as a requirement for their child to partake in the study. The parents were assured that they could remove their child from the investigation at any given point, also being engaged in detailed conversations and interviews so as to guarantee that they possessed a full understanding of the procedures and background of the research. The students' privacy was absolutely prioritised and adhered to at all times, and all gathered information/data was kept confidential throughout the course of the research and after.

To establish the content validity of the interview tasks, a draft of the interview material was reviewed by several different faculty members of Al-Jouf university and by various teachers and supervisors of the Science Education course. The reviewers were asked to comment on the overall appropriateness of the interview content and on the research aims. Four researchers independently coded the data for verbal justification, and the inter-related reliability coefficient was shown to be within acceptable boundaries (88%). Test reliability was measured using a trial sample (selected randomly from grade 1 students who were not a part of the research sample) to carry out a pilot study. The pilot study's participants were selected in the same way as the main research participants. All of the key processes involved in the research, including the interview and in-classroom activities, were practiced during the pilot study; this enabled the researcher to become more familiar with the data collection and overall process.

In the main research, the pre-test was completed first; after a three-week period, the test was completed once again, and a reliability coefficient of 0.84 was calculated with the application of the Pearson formula. This value is appropriate for the research's overall aims.

Research Results

Children's Knowledge of the Taxonomy of Living Things

Analysis of the pre-test revealed that the preconceptions of classifying living things held by the children within the sample were somewhat limited in regards to plants, as more than half of the subjects were unable to correctly classify plants as living things in each instance. The plants that were most commonly classified incorrectly as non-living things were a lily of the valley, a houseplant and an olive tree, with 11/40 children, 12/40 children and 13/40 children, respectively, classifying each incorrectly. The plant that was most commonly classified correctly was the apple tree, which all of the children classified as a living thing. Nonetheless, less than half of the whole sample was unable to correctly classify plants as living things in each of the cases detailed in Table 1.

On the other hand, most of the first-grade children were able to correctly classify animals and artefacts as living and nonliving things, respectively, due to their familiarity with these items. When asked to classify animals as living things, the dog and sheep were most commonly chosen. It is interesting to note that more than 75% of the children in the sample were correct in their classification of animals as living things among the examples, with the turtle being the exception that was incorrectly classified.

When it came to classifying artefacts, the train was most commonly classified correctly as a nonliving thing; however, in much the same way as classifying animals as living things, more than 75% of the children in the sample were correct when it came to classifying artefact taxonomy.

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Table 1.   **Frequency of correct classification of plants, animals and artefacts as living or nonliving things by grade 1 students (pre-test).**

Category	Case	Frequency among grade 1 students (*N*= 40)
Plants	Daffodil	15
	Apple tree	19
	Houseplant	13
	Lily of the valley	11
	Palm tree	16
	Olive tree	13
	Cactus	16
Animals	Duck	31
	Cat	35
	Cow	34
	Bird	33
	Turtle	15
	Sheep	39
	Dog	39
Artefact	Plate	35
	Car	32
	Balloon	32
	Pants	35
	Train	36
	Bicycle	34
	Rocking chair	31

Sample Justifications of Classification of Living Things

Table 2 lists all the patterns that were recognised in the children's justifications of their classifications. This exhaustive list was created prior to the pre-test and was used to identify and categorise the children's justifications. As justification was considered to be key in revealing student misconceptions regarding the classification of living and nonliving things, identifying the patterns present in the sample group was an important step. The identified patterns were subsequently used when planning the lessons given after the pre-test.

Table 2.   **Reference guide for categorising grade 1 students' justifications of their classification of living and nonliving things.**

Category of justification	Description of justification	Examples
Perceptual	Children mention the item's size or other perceptual characteristics without referring to function or motion.	'The plant has leaves.' 'The dog has a tail.'
Motion-related	Children refer to movement or absence of movement.	'The ball is rolling.' 'Usually, the dog is running.' 'Normally, the cactus is planted.'
Biological	**Life:** Children verbally refer to life. **Structure:** Children refer to inner structures. **Properties:** Children refer to biological properties or processes.	'The cow is alive.' 'The train is not alive.' 'The sheep has bones.' 'The cat can grow.' 'The bird can eat.'

As shown in Table 3, there was a high occurrence of children not providing a justification to support their classification of plants as living or nonliving things. The children's ideas on plant taxonomy were somewhat limited, and they found this classification task somewhat challenging. It was notable that when categorising artefacts, a large proportion of the Saudi children in the sample identified nonliving things through their lack of movement, rather than using justifications based on perception or biology. A focus on movement could help to explain why more than 50% of the sample were not able to correctly categorise plants as living things (see Table 1). Conversely, when Saudi children were labelling animals as living things, the most common justification was based on biology, rather than perception or motion (Table 3). This finding may help to explain why more than 75% of the sample could correctly identify animals as living things (see Table 1).

Table 3. **Frequency table of grade 1 students' justifications for their classification of plants, animals, and artefacts as living or nonliving things (pre-test).**

Group	Justification types
Plants	
42	No response
27	Perceptual
25	Motion-related
9	Biological
Animals	
14	No response
26	Perceptual
29	Motion-related
157	Biological
Artefacts	
18	No response
58	Perceptual
142	Motion-related
17	Biological

The Effect of iPad Use on Children's Classification of Living and Nonliving Things

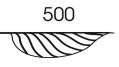Table 4 shows that within the group exposed to a traditional approach to teaching, the children's ability to correctly classify plants as living things remained limited in the post-test. For example, there were only minor differences between pre-test and post-test results on the classification of the cactus and palm tree. For lily of the valley, there was even a decline in the number of correct responses, from 6 to 4.

Table 4. Frequency of correct classification of plants, animals, and artefacts as living or nonliving things among grade 1 children before and after traditional teaching or iPad-based teaching from the socio-cultural perspective.

Teaching with iPad (experimental group)		Traditional teaching (control group)		Case
Pre-test (*N*=20)	Post-test (*N*=20)	Pre-test (*N*=20)	Post-test (*N*=20)	
Plants				
7	16	8	12	Daffodil
9	15	10	13	Apple tree
7	14	6	9	Houseplant
5	18	6	4	Lily of the Valley
8	17	8	9	Palm tree
7	18	6	14	Olive tree
8	18	8	9	Cactus
Animals				
15	20	16	19	Duck
18	20	17	20	Cat
18	20	16	17	Cow
16	18	17	18	Bird
7	19	8	12	Turtle
20	20	19	20	Sheep
19	20	20	20	Dog
Artefact				
17	20	18	19	Plate
15	20	17	18	Car
16	20	16	18	Balloon
17	20	18	18	Pants
18	19	18	19	Train
18	20	16	20	Bicycle
15	20	16	18	Rocking chair

On the other hand, notable differences were observed between the pre-test and post-test findings for the experimental group exposed to teaching using an iPad according to the socio-cultural perspective. This particular approach to teaching had a significant impact on children's ability to classify plants as living things.

Both groups of children showed improvement in their classification of animals and artefacts, with almost all of the experimental group of children being able to provide correct answers for each case following the use of iPads based on the socio-cultural perspective. The findings of the paired *t*-tests emphasise a number of key differences between the pre-test and post-test scores across the experimental and control groups, suggesting that children's ability to classify living things improved following both approaches (Table 5 and Table 6).

Table 5. Pre- and post-test statistical differences following the use of a traditional teaching style (control group).

Stat. \ Var.	N	M	SD	df	t	p
Pre-test	20	14	2.32	19	10.77 -	.001
Post-test		19.6	1.27			

Table 6. Pre- and post-test statistical differences following teaching with iPads based on the socio-cultural perspective (experimental group).

Stat. \ Var.	N	M	SD	df	t	p
Pre-test	20	14.20	2.31	19	4.58 -	.001
Post-test		16.30	2.08			

However, Table 7 reveals a statistically significant difference at the 0.001 level when considering the mean scores across the learning gains for both groups after teaching; the experimental group showed greater results and the calculated *t* value for the difference was 6.05, which is a high statistically significant value. This finding indicates that teaching with iPads in line with the socio-cultural perspective (i.e. with group work and group discussion) has a positive effect on the development of Saudi children's ability to classify living things.

Table 7. Statistical difference between control and experimental groups.

Stat. \ Var.	N	M	SD	df	t	p
Experimental group	20	19.60	1.27	38	6.05	.001
Control group	20	16.30	2.08			

After both types of teaching, the children provided a greater number of justifications based on biological considerations than on other types of justifications, especially perceptual justification.

In addition to the notable differences between pre- and post-test scores when using an iPad for teaching, slight differences were visible between the pre- and post-test scores when using a traditional teaching style. This finding can help to explain why more than 75% of the participants were correct in classifying each type of plant as a living thing (see Table 4) after teaching with an iPad.

Interestingly, regarding artefact classification, the post-teaching scores following exposure to a traditional teaching style showed a greater degree of inaccurate justifications. On the other hand, the pre- and post-test scores for artefacts revealed significant differences after teaching with an iPad. For example, the number of scientific responses (i.e., justification based on biological aspects) increased from 9 (pre-test) to 98 (post-test).

The results of the paired *t*-tests reveal significant differences in the pre- and post-test scores for the justifications given by the children across both groups. This finding suggests that the children's ability to justify their classification improved after both traditional teaching and teaching with an iPad (see Table 9 and Table 10).

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Table 8. Grade 1 students' justifications of their classification of plants, animals, and artefacts as living or nonliving things before and after teaching with iPads according to the socio-cultural perspective or traditional teaching.

Teaching with iPad (experimental group)		Traditional teaching (control group)		Justification types
Post-test (*N*=20)	Pre-test (*N*=20)	Post-test (*N*=20)	Pre-test (*N*=20)	
Plants				
12	20	18	22	No response
9	13	15	14	Perceptual
9	13	17	12	Motion-related
86	5	20	4	Biological
Animals				
1	6	7	8	No response
8	14	11	12	Perceptual
9	15	13	14	Motion-related
119	78	95	79	Biological
Artefact				
2	6	7	12	No response
10	24	28	34	Perceptual
29	77	68	65	Motion-related
98	9	27	8	Biological

Table 9. Statistical differences between pre- and post-test scores after traditional teaching (control group).

Stat. / Var.	*N*	*M*	*SD*	*df*	*t*	*p*
Pre-test	20	4.55	2.16	19	5.21 -	.001
Post-test		7.10	2.17			

Table 10. Statistical differences between pre- and post-test scores after teaching with iPads (experimental group).

Stat. / Var.	*N*	*M*	*SD*	*df*	*t*	*p*
Pre-test	20	14.60	2.32	19	26.77 -	.001
Post-test		15.15	1.27			

Nonetheless, Table 11 shows the statistically significant differences at the 0.0001 level between the mean scores of learning gains regarding justifications in the post-test in favour of the experimental group; the calculated *t* value is 13.44, which is a high statistically significant value. This result shows that teaching with iPads in line with the socio-cultural perspective (i.e. with group work and group discussion) has a positive effect on the ability of grade 1 Saudi children to justify their categorisation of plants, animals, and artefacts as living or nonliving things.

Table 11. Statistical differences between the average scores of the experimental and control groups following exposure to teaching with iPads in line with the socio-cultural perspective or traditional teaching methods.

Stat. Var.	N	M	SD	df	t	p
Experimental group	20	15.15	1.57	38	13.44	.0001
Control group	20	7.10	2.17			

Effects of iPad Use in Line with the Socio-cultural Perspective in Relation to Children's Use of Biological Justifications

Prior to teaching, when children used biological justification, their reasoning relied on a variety of biological aspects – namely, life, inner structures, and biological processes or properties (Table 2). When classifying animals as living things, however, most of the justifications provided related to structural anatomy (e.g. 'the animal has a backbone').

On the other hand, after teaching, especially after teaching with iPads, the children adopted higher level justifications and provided properties of living things (e.g. 'needs food', or 'grows') to justify their classification. When classifying animals as living things, the number of accurate justifications based on biological aspects increased post-test across both teaching styles.

Table 12. Frequency of children's biological justifications of plants, animals, and artefacts as living or nonliving things before and after exposure to teaching with iPads based on the socio-cultural perspective, or traditional teaching.

Teaching with iPads (experimental group)		Traditional teaching (control group)		Type of biological justification
Post-test (N=20)	Pre-test (N=20)	Post-test (N=20)	Pre-test (N=20)	
Plants				
2	5	17	4	Life
20	0	3	0	Structure
64	0	0	0	Properties
Animals				
4	10	11	12	Life
32	64	73	62	Structure
83	4	11	5	Properties
Artefacts				
6	8	18	6	Life
10	1	7	1	Structure
82	0	2	1	Properties

Discussion

In the present work, individual interviews were carried out across a sample of 40 grade 1 Saudi students to identify their ability to classify plants, animals and artefacts as living or nonliving things, along with their ability to justify their classification. More than 50% of the sample are unable to correctly classify each type of plant as a living thing, whereas more than 75% of the sample are able to correctly classify animals as living things, with the

exception of the turtle. This finding aligns with the results from various other works, such as those by Carey (1985), Inagaki and Hatano (1996) and Patrick and Tunnicliffe (2011), who reported that children recognise the biological aspects plants later than those of animals. However, the results of the present research do not align with those garnered by Campos et al. (2012), who reported that students are better informed in regards to plants than animals.

Younger children have a tendency to view things as living if they move, which may help to explain the difficulty the children in this sample had with classifying plants as living things. Movement is recognised as a perceptual clue that assists young learners in identifying living organisms (Brulé et al., 2014).
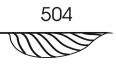
The present research revealed that grade 1 Saudi children have varied misconceptions about living things in terms of both classification and justifications, especially for plants. Accordingly, it is fundamental that when students first enter school in grade 1, the teachers ensure that they are well informed concerning animals and plants. The present research explores the baseline knowledge of children upon their enrollment in school, which is important because children are likely to bring their own prior understanding and views into the learning environment (Driver et al., 1985; Osborne & Freyburg, 1985). Thus, it is necessary for teachers to address their students' current state of knowledge rather than applying restrictive resources. In other words, additional teaching approaches and resources must be utilised.

The results of this research demonstrate that the suggested teaching method of iPad use based on the socio-cultural perspective (i.e. with group work and group discussion) has a positive effect on grade 1 Saudi children's development of knowledge in classifying plants, animals, and artefacts as living or nonliving things, and in justifying their classification. Such teaching is shown to assist children in categorising plants and animals as living things, and in using biological aspects to justify their classification. More specifically, the current research explores children's use of biological justifications and their overall content, and demonstrated that children use a higher level of justification when recognising a living thing's need for food and its tendency to grow.

Prior to teaching, more than 50% of the children do not classify plants as living things. This finding is supported by the results of Zogza and Papamichael (2000), who reported that the criterion of motion is a 'cognitive obstacle' to the categorisation of living objects. Furthermore, Opfer and Siegler (2004) reported that 5-year-olds tend to recognise plants as living after they are taught that plants can perform teleological movements, such as moving towards the sunlight. So and Ching (2015) found that the children not only enjoyed learning with the use of online resources, but also demonstrated greater understanding of animal taxonomic classification, and were better able to provide examples and characteristics of those in each group.

The findings garnered by the present research can be interpreted using the notion of the ZPD, as discussed in the work of Vygotsky (1978). The class work was beyond an appropriate ZPD for the children in terms of non-scientific framework theories; for example, motion is not viewed as a fundamental characteristic of plants being alive, so the scientific ideas being taught in class conflicted with the children's prior framework theories. Thus, the in-class group discussions between children that occurred in the present research were valuable, as they gave the children a different way of viewing the world. The results of the present research suggest that children's classification of living things can be developed through the use of cultural tools such as language and iPad use, which improve child-child and child-teacher interactions. According to Leddon et al. (2008), 7-year-olds have a good understanding of the concepts of life and biological properties (Brulé et al., 2014). Nonetheless, the current research showed that 6-year-olds were able to utilise higher level biological justifications. Springer (1999) states that by the age of 4 or 5, a number of children have gained some insight into the theory of biology; Springer also states that one of the critical factors driving the acquisition of a naïve biology may be the acquisition of factual knowledge, in combination with particular key inferences that stem from this knowledge.

The findings of the present research are valuable, as they provide knowledge on the type of properties children focus on when comparing plants and artefacts, or animals and plants. It is important to note that experiential and socio-cultural elements enrich cognitive dimensions, as children are social beings whose thoughts are influenced and shaped by their interactions and activities; thus, iPads can help to develop learning and knowledge among students and improve the quality of learning and teaching (Keengwe, 2007). As Tay (2016) suggested iPad use increases children's involvement in learning and in more wide-ranging, real-word purposes, connectedness and exploration. Accordingly, it might be worthwhile to carry out a comprehensive research based on investigating and supporting within the phenomena studied through teacher-child dialogue and child-child dialogue, and the use of cultural artefacts.

Conclusions

This research carried out individual interviews of 40 grade 1 Saudi students to identify their ability to classify plants, animals and artefacts as living or nonliving things, along with their ability to justify their classification. It was found that the use of iPads according to a socio-cultural perspective had a positive effect on children's knowledge development. As these findings show, iPad use based on the socio-cultural perspective in the form of group work and discussion has a positive effect on grade 1 Saudi children's ability to classify plants, animals, and artefacts as living or nonliving things, and on their ability to justify their classification.

The present research yields a number of implications for teaching young children about living things. First, it is necessary for teachers to identify the knowledge levels of their students in relation to non-scientific and scientific framework theories. All students should be provided with the opportunity to expand their framework theories within the learning environment; merely outlining their beliefs is not adequate in this regard. There is value in teachers presenting the idea of classification to primary students, in order to direct their attention towards the differences between living and nonliving things, and the use and type of biological justifications, especially in relation to the properties of higher level justification. Nonetheless, children's learning should not only be established in line with age development; rather, there is a need to consider and analyse how children think, in addition to how children may be acknowledged as valuable knowledge creators. Further research is needed to investigate whether children from iPad group express greater interest in living things in online world or in real world (compared with control).

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