Early Childhood Special Science Education: setting the frame of a newly born and well-promising trend

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Abstract

The last three decades two distinct trends have emerged within Early Childhood Education, namely Early Childhood Science Education and Early Childhood Special Education. The current paper tries to move along these areas and illuminate the common ground that lie between them. In particular, drawing from the formulated empiricist, Piagetian and socio-cognitive trends within Early Childhood Science Education, it tries to explore to what extend they could expand in special needs context. In addition, it proposes diverse, specific strategies that emerge from the above-mentioned trends and could be implemented in teaching science within special needs settings. By so doing, the present paper aspires to set the frame of a newly born and well-promising trend, that of Early Childhood Special Science Education.

Keywords

Science Education, Special Education, Early Childhood Education

Résumé

Au cours des trois dernières décennies, deux tendances distinctes ont émergé au sein de l'éducation de la petite enfance : l'éducation scientifique de la petite enfance et l'éducation spéciale de la petite enfance. Le présent article tente de se déplacer le long de ces zones et d'éclairer le terrain d'entente qui se trouve entre elles. En particulier, en s'inspirant des tendances empiristes, piagétiennes et *sociocognitives formulées au sein de l'éducation scientifique de la petite enfance, il tente d'explorer dans quelle mesure elles pourraient s'étendre dans le contexte des besoins spéciaux. En outre, il propose des stratégies diverses et spécifiques qui émergent des tendances susmentionnées et pourraient être mises en œuvre dans l'enseignement des sciences dans des contextes de besoins spéciaux. Ainsi, le présent document aspire à établir le cadre d'une tendance récemment née et bien prometteuse, celle de l'éducation scientifique spéciale de la petite enfance.*

Mots-clés

Didactique des Sciences, Éducation Spéciale, éducation de la petite enfance

Theoretical framework

Since the foundation of the first kindergarten in Watertown, Wisconsin (USA) in 1856, the field of Early Childhood Education has been amended to great changes and evolvement. Central role to this process has played the formulation of diverse child development theories which flourish in the mid of the twentieth century (McLean, Sandall, & Smith, 2016). Prominent theories such as Piaget's theory of cognitive development (Piaget, 1950) and Vygotsky's theory of social construction of knowledge (Vygotsky, 1978) determined to a large extent research trends and practices. Within this context, two distinct trends have emerged the last twenty-five years within Early Childhood Education, namely Early Childhood Science Education and Early Childhood Special Education. number of researchers have tried to shed light into the common ground of these two fields, trying to extend the features that govern the former trend to the latter one (Brigham, Scruggs & Mastropieri, 2011; Chia, 2011; Kaliampos, Ravanis, & Vavougios, 2020; Melber, 2004). Being in its initially phase, this tendency is expected the next years to give birth to a new trend called Early Childhood Special Science Education.

At that old times in the mid of nineteenth century, where the first public kindergarten and nursery schools where established, students with disabilities used to live in the margin of any kind of educational context. Their enrollment to school was often denied and the provision of services to them was out of the agenda. Mothers had to stay in home with their disabled child, almost socially isolated, trying to teach him/her to walk or say a few words (McLean et al., 2016). Since then, numerous of different acts and programs such as the Head Start program, the Education for All Handicapped Children Act and the Individual with Disabilities Education Act (IDEA) had totally changed the position of children with special needs in the school context. Passing successively from institutions to separate, 'special' schools and then to integration classrooms, preschool disabled children started to receive education and specialized help (Francisco, Hartman, & Wang, 2020; Kahn, Pigman, & Ottley, 2017; Vinovskis, 2008). Landmark in the history of special education constitutes the Salamanca Declaration which was signed in June 1994 by 92 governments and 25 international organizations in partnership with The United Nations Educational, Scientific and Cultural Organization (UNESCO). According to this Declaration, a philosophy of acceptance and respect for all children irrespective of their disabilities should govern every educational movement. Inclusive education is adopted, and it becomes compulsory and extremely important for all, both for typical development students and students with learning disabilities under the umbrella of 'School for All'. Within inclusive schools, disabled children should receive whatever extra support they may need in order to ensure their effective education while assignments to special schools should be recommended only in cases where there is no alternative (UNESCO, 2009).

Nowadays, children with delays and disabilities hold a distinct place in education, often constituting a significant proportion of the general population of the classroom. Indicatively, in 2018 more than 1 million handicapped children in states of America, aged 5 years and below, received special treatment under public school domains (Kasprzak et al., 2020). Nevertheless, these students seem to face difficulties in everyday school practice and rarely manage to progress at the same pace with general population, often leading at lower graduation rates (Buckrop, Roberts, & LoCasale-Crouch, 2016). Regarding science success, literature findings are even more alarming. Despite a number of enactments and policies that have been emerged the last decades within science education field concerning special education, among them the 'No Child Left Behind' act (NCLB) of 2001, the 'Science for All' and the 'National Science Education Standards', children with disabilities still seem unable to accomplish success in science (Aydeniz, et al., 2012; Villanueva & Hand, 2011). As data explicitly show, they often underperform on a number of standardized science assessments and tend to score significantly below their peers in science achievements (Kahn et al., 2017; Villanueva et al., 2012).

Failure of preschool pupils with disabilities into science becomes even more imperative if we consider that early learning has a substantial effect on later achievement. As Butera et al. (2014) point out, science instruction along with mathematics lay the foundations that will enable children to acquire the basic cognitive and noncognitive skills of problem solving. These thinking processes may apply to all domains of development and are likely to enhance students with the basic tools to develop complex skills and knowledge in the future (Hardy & Hemmeter, 2020). Diverse policy statements, states and regulations support this view and regard early science as array of predictor for later achievement. As a result, an increased trend on science and mathematics is apparent nowadays in preschool curriculums around the world (Butera et al., 2016). Along this line, preschool pupils with and without disabilities are expected to successfully participate in early science activities that will help them to foster motivation and positive attitudes to learning such as persistence and flexibility (Hardy & Hemmeter, 2020).

A prominent reason for the underperformance of disabled pupils into science could lie into the way inclusion is enhanced into school practices. Indeed, while a large body of research clearly illustrate the benefits of inclusion, at least on a theoretical basis, there seems to be a gap between the research base and the reality of effective practices that govern inclusive programs (Brotherson et al., 2001). Consequently, often enough students with disabilities are not given the opportunity to experience high-quality inclusion in education settings (Winton, 2016). In addition, the implementation of inclusion in an efficient way is often hindered by the inadequate training that teachers receive to fulfil their particularly demanding role. This is well reflected on a national online survey of almost 1100 science teachers which received little formal training on their pre-service preparation and were feeling totally unprepared to teach students with disabilities in an inclusive context (Kahn & Lewis, 2014). As Villanueva et al. (2012) points out, science education programs rarely turn their attention into the wilderness of special needs while special education programs often lack any kind of reference into science courses. Consequently, teachers often feel inadequately prepared and face difficulties to deal with science in inclusive settings (Brigham et al., 2011)

Methodological framework

Research questions

While the above-mentioned reasons regarding the difficulty of pupils with disabilities to accomplish success in science hold true, it seems that they entail just a small piece of the puzzle. More theoretical research on Early Childhood Special Education with focus on science education is needed to set the framework of the new promising trend called Early Childhood Special Science Education. This research data will expectantly empower early educators and equip them with the appropriate tools for designing specific teaching interventions to meet their students' needs in science inclusion settings.

The present study seeks to move along this line and illuminate the common ground that lie between two prominent, distinct research areas namely Early Childhood Science Education and Special Needs Education. Particularly, it tries through a thoroughly view to explore to what extend the trends that were proposed by Ravanis (2017, 2021) and seem to dominate early childhood science education could expand in special needs context. In its attempt to do so, it draws to the literature and provides to the reader a review of academic researchers in this area. Going a step further, it seeks to look closely at specific didactic strategies that has been proposed by pioneers of special education in teaching science and tries to fit them into the basic theoretical frameworks of early childhood science education. By so doing, it aspires to contribute to the formalization of the new trend called Early Childhood Special Science Education. More specifically, the current study tries to answer the following two research questions:

What is the role of the formulated empiricist, Piagetian and socio-cognitive trends within Early Childhood Science Education in special needs context?

What specific science teaching strategies could emerge from the application of empiricist, Piagetian and socio-cognitive trends into special needs settings?

Literature review methodology

In order to fulfill this purpose, a literature review methodology was adopted. The strength of this methodology lies on the fact that it equips the researcher both with the fundamental and the expert knowledge on a specific research area as well as its interconnection with other research areas too. So, far from being a simple discussion about the advantages and disadvantages of a certain topic, literature review goes a step further and enables the researcher to explore the theories that govern a specific subject along with their controversies and their limitations (Hart, 1998). To quote Ramdhani, Ramdhani, & Amin (2014, p. 48) "*it gives an overview of what has been said, who the key writers are, what are the prevailing theories and hypotheses, what questions are being asked, and what methods and methodologies are appropriate and useful*".

Within this study, the core aim of the literature review was to provide an organized overview of two distinct areas called Early Childhood Science Education and Early Childhood Special Education and explore conceivable similarities between them. Having formulated the research questions, a multitude of articles were thoroughly studied and analyzed from the perspective of a new trend called Early Childhood Special Science Education. To do so, data was synthesized and reclassified in order to be compliant with the research purposes (Pare & Kitsiou, 2017). During this process the structure of the manuscript was illuminated and specific arguments that set the frame of the new trend were elaborated. In the next sections the outcomes of the aforementioned process is elaborated.

Results

1st Research question: What is the role of the formulated empiricist, Piagetian and socio-cognitive trends within Early Childhood Science Education in special needs context?

While the above-mentioned reasons regarding the difficulty of pupils with disabilities to accomplish Since 1990s, diverse approaches with different goals and perspectives have been aroused within Early Childhood Science Education. These orientations have been changed over time with the relative research adding and subtracting key elements of them. In an attempt to classify the approaches, Ravanis[1] (2017) proposes three main, distinct trends which seem to determine in a large extent the contemporary framework. These namely are the empiricist, the Piagetian and the socio-cognitive approach. In what follows, an attempt is made to set these approaches in the setting of special education and shed light into their state and perspectives.

Empiricist approach in special education setting

Having its roots in traditional early childhood pedagogy, empiricist approach makes use of the early behavior attitudes towards learning. At the center of the process lies the teacher who tries to 'transfer' physics knowledge to children's thinking via setting the subject, guiding teaching activities, presenting experiments and asking questions (Ravanis, 2017, 2021). While this kind of explicit or direct instruction has been criticized in the past and looks obsolete nowadays in the general education context, this does not seem to be the case in special needs setting (Lenjani, 2015). Indeed, commonly manifested statements such as '*I wouldn't adopt this book, it's too behavioral*' and '*this behavioral program is turning children into robots*' cannot gain ground in special needs context, as behaviorism has served as one of the major classical theories for early childhood special education practice (Odom, 2016; Strain et al., 1992). Being the conceptual foundation for a variety of 'best practices', behaviorism impacted and continues to impact a variety of intervention strategies for children with disabilities (McLean et al., 2016).

Lenjani (2015) support the claim that behaviorism is an effective and efficient approach in improving learning outcomes for students with disabilities pointing out that the structured, manageable segmentation of didactic intervention is clearly for the benefit of students. Particularly he states that introducing only one step of the scientific method each time, such as the statement of the problem during a science lesson on sound, gives the opportunity to students with special needs to remain focus on the teaching process while avoiding any kind of frustration than often overwhelms their thinking. This structure and systematic planning, that is inherently involved at the core of explicit teaching and direct instructional lessons, gives to the lesson a predictable form that seems necessary to students with disabilities (Lenjani, 2015).

A prominent structured approach that is often adopted within early childhood special education is Behavior Analysis Application (ABA). Drawn from behaviorism theory, ABA can support special educators to fulfil their scopes towards their instructional challenges, teaching new academic skills among them (Anderson, Marchant, & Somarriba,

1 In Ravanis (2017) classification there is reference in another, fourth trend named socio-cultural approach which is gradually taking up more and more space. Nevertheless, this trend is not analyzed in the current paper, as it is not considered to be a traditional trend in science education

2010). Diverse techniques are commonly used under the term umbrella of ABA. To quote Odom (2010, p. 23), these techniques quite often include "…*selecting activities that are interesting for children, organizing the material and environment that will lead the child to initiate the behavior or skills to be learned, providing support when needed*…". At the core of these techniques lie the positive and negative reinforcements that can be very effective in dealing with students that fall into special needs spectrum such as pupils with autism, delayed developmental disorders and/or antisocial behavior (Lenjani, 2015). This is well reflected in Ryan's case, a five-year-old pupil who was diagnosed at the age of three with a developmental delay in speech and language. Ray was continuously avoid performing particular academic tasks and was keen to ran away, refusing to work. Due to the positive effects of an ABA based intervention program, which used high levels of encouraging reinforcement, Ryan managed to totally increase the number of performing specific academic tasks. By doing so, he managed to remain in the general education classroom (Anderson et al., 2010).

Piagetian approach in special education setting

Piagetian approach draws its basic characteristics from the core theoretical elements of Piagetian Genetic Epistemology. Central to this approach is the continuous interaction of the child with the world around him/her. Through this interaction, the child has the opportunity to engage in physical-knowledge activities and through them interact with diverse objects at their disposal (Ravanis, 2017). These kinds of hands-on activities have been proposed by a number of special educators and researchers in order to introduce pupils with disabilities in the natural worlds in early childhood (Donegan-Ritter, 2017; Hardy & Hemmeter, 2020).

Melber (2004) refer to hands-on activities and state that the more a pupil can handle an object and experience its characteristics, the better. Interestingly, far from being exotic and expensive, cheap and easy-to acquire items can perfectly grab student's attention and introduce them into learning process. A pinecone, a shell or a backyard critter can generate excitement and provide pupils with special needs authentic life-science experiences. Success of hands-on activities on mildly handicapped pupils was also shown on a study of Bay et al. (1992). Particularly, 10 pupils with learning disabilities (LD) and 6 with behavioral disorder (BD) distributed in three elementary schools in Chicago were more verbally engaged and scored higher performances in a discovery teaching condition. In line with these findings stands similar studies with students lying on different spots across special needs spectrum (Brigham et al., 2011; Scruggs et al., 1993)

Socio-cognitive approach in special education setting

Drawing from the post-Piagetian theories on learning along with Vygotsky's theory of social construction of knowledge, socio-cognitive approach has emerged the last decades within science education and has exerted a strong influence in the field (Ravanis, 2017). Central role on that approach hold the mental representations of children about the natural phenomena of the world around them. A number of prominent researchers within Early Childhood Science Education field have extensively recorded and studied these mental representations of children aged 4-8 in several learning cognitive areas such as biology (Ergazaki & Zogza, 2013), meteorological phenomena (Fragkiadaki & Ravanis, 2015), shadow formation (Pantidos, Herakleioti, & Chachlioutaki, 2017), thermal phenomena (Kaliampos & Ravanis, 2019) and electricity and magnetism (Christidou et al., 2009; Kalogiannakis, Nirgianaki, & Papadakis, 2018). What is noteworthy here is that these mental representations are not idiosyncratic. Far from it, they constitute a coherent model in children's minds, which enables them to cope with the world and make predictions. As a result, a conflict exists in children's mind between their intuitive ideas and the scientific ideas which are taught in school. The role of the teacher therefore is to to adjust their teaching into these representations and create the appropriate conditions of cognitive transformation (Stavrou, Michailidi, & Sgouros, 2018). Within this constructivism context, in recent years the concept of precursor models has emerged. These are "*cognitive entities which interpose themselves between the original children's representation and the scientific models used in education*" (Ravanis, 2017, p. 285) and quite often constitute teaching and learning goals for science educators.

While socio-cognitive approach has dominated science education the last decades for typical developed students, its usage has not expanded into special education spectrum (Odom, 2016). Scruggs and Mastropieri (1994) refer to this stated that one major shortcoming of constructivism is its confinement in general education context and its lack of attention into students with learning difficulties. At the heart of this criticism lie the fact that these students would not be able to fully participate in free-choice activities without specific instructional strategies. That is, in a constructivism setting where students are expected to choose their activities in an independent manner, disabled children may lose their orientation and eventually not access the maximum potential of learning that was available in their environment (Carta et al., 1991).

Whereas this criticism holds true, quite a few researchers have tried the last years to explore socio-cognitive approach in the wilderness of special education spectrum. Kaliampos et al. (2020) explored alternative conceptions of impetus theory and projectile motion of students with high functioning autism spectrum disorders through the development of a computerized, well-structured tool called T.E.A.I.A. Their findings suggest that these students tend to use almost the same alternative conceptions with those used by typical development students, on a different frequency thought. Quite interestingly impetus theory was adopted in a statistically different rate between the two study groups, with the authors resorting to Empathizing-Systemizing theory to deal with this discrepancy (Baron-Cohen et al., 2001).

In addition, Kaliampos (2015) investigated alternative conceptions of force and gravity on a small scale, qualitatively study with 3 secondary students with autism through directive, individual interviews. While his findings showed that both typical development and autistic students hold almost the same alternative ideas, fairly surprisingly autistic students did not use at all the common in the academic literature 'push-pull' force model. Tselfes et al. (2006) also explored alternative conceptions of force on students with learning difficulties and concluded that their ideas did not differ significantly to those of typical development.

Maleza and Kalogiannakis (2012) tried to incorporate constructivism theory into inclusion context. Particularly, in the framework of parallel support they explored, through the usage of ICT, how constructivism approach could be implemented into teaching. Research findings showed that their lessons, which took into account both the particular needs and the prior knowledge of the student, had beneficial effects on the autistic students, as he actively participated in teaching and learning process. Moreover, the extra outburst of him was to a limited extent. Other researchers have also come to similar conclusions regarding the positive effects of constructivism into special needs settings (Scruggs & Mastropieri, 1994; Scruggs et al., 1993).

2nd Research question: What specific science teaching strategies could emerge from the application of empiricist, Piagetian and socio-cognitive trends into special needs settings?

Judging from the above, the basic trends that have dominated Early Childhood Science Education, namely empiricist, Piagetian and socio-cognitive trend acquire a diverse role when they are looked in special needs' context. That is, the particular demanding role of special needs inevitably sets the examination of their effectiveness in a totally different context. Therefore, as Lenjani (2015) points out, an amalgamation of these trends is necessary in their implementation in the wilderness of special needs. It is this mix of key concepts of constructivist and behaviorist ideologies that could lead to effective strategies in teaching science to students with disabilities. Along this line, Butera et al. (2016) refer to intentional teaching as an instructional approach that balances child-initiated interactions with adult-directed guidance and support. In this context, historical differences along Early Childhood Science Education and Early Childhood Special Education could find common ground in Early Childhood Special Science Education

In particular, drawing from constructivism theory teachers should enhance questioning in their teaching. Nevertheless, instead of open-ended questions which aim to elicit general pupils' ideas about a number of phenomena, here the question should have a more attention-focusing direction (Donegan-Ritter, 2017). That is, rather than the 'why' the 'what' questions should be qualified. To sample some of them '*what ingredient do you notice makes lifespan of a soap bubble longer?*', '*what is your friend doing with his trial tube?*' or '*what is your friend doing to make the soap bubble move?*' By so doing, pupils with disabilities are helped to concentrate on variables they tend to overlook. Scruggs and Mastropieri (1994) also refer to this and point out that highly structured and guided questions is essential for knowledge construction to take place in special needs setting. It is this reinforcement that help disabled pupils to refocus in their task and keep their thinking systematic.

In addition, quite importantly teachers should be able to offer the possibility to their students to express their ideas through a variety of materials and formats. That is, a variety of pictures and drawings could be implemented in the teaching process to help children with limited communication skills Donegan-Ritter (2017). What is more, multiple means for receiving information could meet the diverse learning styles that often characterize pupils with disabilities. Some of them may grasp information more readily by seeing what is presented to them, others by hearing it or even touching it (Butera et al., 2016). For example, pupils with autism have highly developed visual thinking and memory skills (Chia 2011; Cihak 2011). Their sharp visual and 'photographic' perception enables them to focus on something that interests them, even in the case they suffer from attention deficit disorder. In fact, their preference for images is so strong that they often prefer to watch the photo of a person they are talking to instead of the person himself (Cihak, 2011). Taking this into account, early educators should try to help these pupils by implementing a variable of photographs, images and drawings into their teaching.

Children's interests and background along with the social and political context of the classroom certainly constitutes a good base for exploring science in special needs setting. For example, if a child's parent work in the recycling plant, learning about recycling may elicit enthusiasm in learning more about recycling (Hardy & Hemmeter, 2020). What is more, pupils' interests and preferences could be highly exploited in the teaching process to arouse children's attention, curiosity and motivation as long as they are incorporated in science activities (Donegan-Ritter, 2017). This is even more vital in the field of special education, as pupils lying on special needs spectrum often show particular interest for specific objects and activities. For example, autistic people are often obsessed with mechanical devices and other natural systems such as meteorology and cloud formation (Baron-Cohen et al., 2001). Typical is the case of a father of a child with high-functioning autism who stressed that his son's interest in meteorological phenomena was so intense that he woke up every 15 minutes at night to watch on television the weather report. As he noted, he barely slept at night (Baron-Cohen & Hammer, 1997). In addition, almost all children with autism are obsessed, at some point in their lives, with a device such as vacuum cleaners, washing machines, electrical alarms, clocks, trains and airplanes (Baron-Cohen et al., 2001). Therefore, teachers should try to capitalize on these interests and make the necessary adjustments to the designment and planning of teaching science activities (Hardy & Hemmeter, 2020). During this process, strategies promoting the balance between the novel and the familiar should be adopted by making meaningful connections between prior experiences and current environments. So, for example while early educator talks about seeds, a child who is interesting in plants could talk about gardening with his grandfather (Butera et al., 2016).

Drawing from Piagetian and socio-cognitive approaches, hands-on activities can certainly promote children's initiation into science content (Brigham et al., 2011; Scruggs et al., 1993). So, for example when learning about how plants grow, instead of an activity were pupils have to color the different stages as the plant grows, the early educator could simply involve children into planting their own seeds and recording plant growth through the semester (Hardy & Hemmeter, 2020). In addition, when learning about the circulatory system, pupils could get into an activity of taking their own pulse before and after exercise (Melber, 2004). These hand-on activities are likely to motivate pupils with special needs and offer them pleasure time during teaching. Consequently, this is likely to lead them on low levels of misbehavior. This was the case on a study of Cawley et al. (2002) were students with learning disabilities and emotional disturbance maintained appropriate behavior as they were engaged on a science program where hands on activities held a prominent role.

In addition to being hands-on, science activities in special needs setting are also important to hold an inquiry dimension. Melber (2004) refer to inquiry-based science stating that this kind of activities requires students to be active investigators by making observations, posing questions, examining books and other information sources, planning investigations, using tools to gather and analyze data, proposing explanations and communicating results. Therefore, considering an activity in which children are investigating the lifetime span of soap bubbles, the early educator can let pupils experiment freely with constructing soap bubbles. Particularly, he/she can encourage children to explore how adding different amounts of dishwashing liquid, sugar or glycerin impacts the time that the soap bubble will move through air before it pops (Hardy & Hemmeter, 2020). By so doing, pupils are engaged in inquiry and have the chance to grasp science in its purest form.

It is important through inquiry-based activities in special needs settings that the disabled children would get the opportunity to participate in a variety of different ways. So, for example when learning about volume, pupils can '*scoop and pour water using different vessels, pour water from one vessel into another, make holes in plastic cups and observe how water drains, and direct the movement of water from one vessel to another* *using plastic tube'* (Hardy & Hemmeter, 2020, p. 6). This kind of adaptations lead children to gain the maximum of knowledge from science activities. Nevertheless, as Kahn et al. (2017) point out, these adaptations should not get confused with actions that often driven by teachers and act at the expense of pupil's autonomy. Such is the case when, during a lesson on floating and sinking, a student with visual impairments is asked to passively stand by and have others to place the objects in water, instead of himself doing so (Kahn et al., 2017).

Discussion

Two centuries along disabled pupils used to live in the margin of any kind of educational setting, with their enrollment in school being an uncertain and painful process. Many steps have been taken since then and the situation has changed radically. A number of different acts and programs, with Salamanca's Declaration holding a prominent role among them, brought children with disabilities to general school classrooms. Nowadays, through inclusion pupils with delays and disabilities hold a distinct place in education, often constituting a significant proportion of the general population of the classroom (Kasprzak et al., 2020). In addition, research in special education has grown extensively acquiring specialization and offering effective intervention to individual with disabilities. Regarding pre-school children, a distinct trend has emerged the last decades within early childhood, known as Early Childhood Special Education.

Nevertheless, despite the flourish of special education in general settings, research findings explicitly show that disabled pupils seem unable to accomplish success in science often underperforming on standardized science assessments (Aydeniz et al., 2012). While a number of factors could contribute to this fact such as the way inclusion is enhanced into school practices or the shortage of early educators in physics, they cannot explain the situation in all its dimensions (Villanueva et al., 2012). More theoretical research on Early Childhood Special Education with focus on science education drawn from Early Childhood Science Education seems to be necessary. This will inevitably lead to the setting of a new promising trend called Early Childhood Special Science Education.

Along this line, the present study tried to explore the role of the formulated empiricist, Piagetian and socio-cognitive trends proposed by Ravanis (2017) within Early Childhood Science Education in special needs context. While empiricist has been criticized in the past and looks outdated in the general education context, it seems to hold prominent role in special settings. Indeed, drawing from behaviorism, direct and explicit teaching has proven an efficient and effective approach in improving learning outcomes for students with disabilities (Lenjani, 2015). Regarding Piagetian trend, the hands-on activities that lie on the center of that approach can certainly play a key role in teaching science to preschool pupils with special needs. Finally, socio-cognitive trend can also play a positive role in special needs. While the criticism on that approach that students would not be able to fully participate in free-choice activities without specific instructional strategies hold true, it is a fact that under circumstances socio-cognitive can undoubtedly exert positive influence into special needs settings (Maleza & Kalogiannakis, 2012). Therefore, it is time constructivism stop being confinement in general education context and explored into the wilderness of special education. In particular, researchers should try to investigate alternative conceptions of preschool children that lie on special needs spectrum. What is more, the role of precursor models could be examined and studied into the light of this spectrum. By so doing, research will pave the way for the new, so called trend of Early Childhood Special Science Education.

Within this trend, an amalgation of key concepts of constructivist and behaviorist ideologies driven from empiricist, Piagetian and socio-cognitive trends could lead to effective strategies in teaching science to students with disabilities. Through intentional teaching, early educators could enhance questioning in their teaching and offer the possibility to their students to express their ideas through a variety of materials and formats (Butera et al., 2016). In addition, they could capitalize on the special interests that are commonly exhibited by pupils within special education and design hands-on activities to promote their initiation into science content. An inquiry-based dimension on that activities can certainly add value to the learning process (Hardy & Hemmeter, 2020).

Judging from the above, common ground seems to exist between the two distinct trends within Early Childhood Education, namely Early Childhood Science Education and Early Childhood Special Education. Within this common ground a newly born and well-promising trend has been slowly emerging in recent years, known as Early Childhood Special Science Education. This trend will hopefully move the next years towards the most central values of special education and act as a barrier in the long health myth of science as an elitist subject reserved for only the 'best' pupils (Melber, 2004).

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