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The Influence of Piaget in the Field of Learning Science

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Abstract

As the most influential figure in the field of learning science, Piaget's research on children's concepts and consciousness, his concept of 'Piagetian education', his contribution to constructivism have been greatly adopted in education. However, the weaknesses of his work have been criticised by many scholars. This paper illustrates how Piaget's work has challenged traditional educational approach regarded as instructionism and the differences between Piaget's and Vygotsky's theories. This paper also discusses and compares the theories proposed by a number of other researchers based on Piaget's constructivism, including Papert's constructionism and his theory of children's use of computers; Lave's situated learning, and Wells' theory of group learning.

Keywords: Piaget, constructivism, Vygotsky, Papert, Lave, Wells

Learning science builds on research from psychology, philosophy, sociology, computer science and other scientific disciplines to study the cognitive and social processes that lead to the most effective learning, enabling people to learn more deeply and effectively (Sawyer, 2014). Piaget (1896 - 1980) is one of the most influential figures in the field of learning science. His research into children's concepts and consciousness, his concept of 'Piagetian education', his contribution to constructivism, and his theory of learning and cognition that challenged the traditional view of schooling known as instructionism (Papert, 1993b), inspired the world and had a huge impact on the way people learned in the twentieth century. His great influence on developmental psychology began in the 1920s and reached its peak in 1970s (Montangero, 1985), but initially his informal work failed to attract enough attention from scholars because it was not considered scientific experimental research (Glenn, 2007). Piaget's work continue to influence the world today, with most studies focusing on the application of his educational theories and limited research focusing on the influence of his research on other psychologists and later studies. This paper collects psychologists' views on Piaget's theory and analyses the extent to which their work has been influenced by Piaget's theory, with Papert (1928 - 2016) creating constructionism and Wells proposing teaching methods based on Piaget's research. It also includes psychologists who opposed Piaget's theory, with the most famous being Vygotsky (1896 - 1934), who criticized Piaget for failing to address consciousness, ignoring the concept of non-spontaneity and established the theory of the Zone of Proximal Development (ZPD), and Lave, who argued that Piaget ignored the influence of culture and environment on learning and cognition and built a theory of situated learning.

Prior to the birth of the science of learning, there were several views within the discipline of educational psychology about how people learn and acquire knowledge. Behaviourism argues that learning can be adequately explained through the association between stimuli and responses without reference to any observable internal states (Glenn, 2007). Logical empiricism proposes that scientific knowledge consists of statements about the world and logical operations that can be applied to those statements (McGuire, 1992). Instructionism consists of behaviourism and logical empiricism and assumes that educational practice is teacher-centred, that teachers are conceptualised as transmitters of objective reality and that students are seen as passive recipients of knowledge (Driscoll et al., 1997). Instructionism curricula are developed under the assumption that children enter schools with empty minds and that the function of school is to fill those minds with knowledge (Sawyer, 2014). Using the learning of the alphabet as an example, Byrne (1996) suggests that it may be prudent to tell children directly how the alphabet works, as it does not seem wise to rely on their own discoveries. Instructionism had a major impact on education by preparing students for the industrialised economy of the first half of the 20th century (Sawyer, 2014).

However, it has been argued that instructionism was failed to educate students to engage with a technologically more complex world (Sawyer, 2014). Piaget argued that the stimulus-response model of behaviourism could not explain cognitive learning. Piaget (1964) suggested that a stimulus can only become a true stimulus when it is assimilated into a structure, and a response can only occur if the structure exists, so the response exists from the beginning, or the structure exists from the beginning. Hence, Piaget proposed that students do not assimilate information and ideas provided by teachers or internalise skills through rote memorization, children can construct knowledge and adapt it to their own cognitive structures. His constructivism gained popularity in education in the late 20th and early 21st centuries (Phillips, 1995), learning was defined as an active process of knowledge construction rather than passive knowledge absorption (von Glasersfeld, 1995). For example, all children may learn the same content, but they adapt it to their own individual perceptions and prior knowledge. As new knowledge is added to prior knowledge, the constant construction of new knowledge activates constant changes in children's cognitive structures. In addition to this, Piaget was the first to take children's thinking seriously (Papert, 1999) and he saw the study of children as a means of explaining the nature of human knowledge (Piaget & Bringuier, 1980). In the traditional sense of psychology and philosophy, children have been regarded as rather uninteresting creatures. Piaget contributed a lot to the cognitive development, social competence and language of infants and children (Erneling, 2014).

Piaget (1964) proposed that the development of knowledge is a spontaneous process influenced by the whole process of embryonic development, including the development of the physical and nervous systems and the development of mental functions, where spontaneous concepts based on children's original reflections on natural (Zuberi, 2002) and children develop primarily through their own mental efforts. Piaget's theory of cognitive development suggests that the development of children's ability to understand numbers is influenced by their physical development. Children must go through certain stages of learning, moving from concrete information to gradually becoming more abstract, regardless of the instruction they receive. His four main developmental stages have provided a very useful framework for educators to construct a meaningful and age-appropriate pedagogy (Glenn, 2007). The first stage is the sensory-motor stage, which lasts until approximately the first 18 months of life. In the first month of life an object has no permanence and ceases to exist when it disappears from the perceptual field. The second stage is the preoperational stage, which is the beginning of language, symbolic functions and thinking. The third stage is the concrete operational stage, which is important for children to have concepts of number, space, sequencing, and time functions. The fourth stage is the formal operations stage. Piaget's work on the stages of intellectual development has had a significant influence on educational practice. However, some scholars believe that Piaget underestimated children's abilities because he described tasks in confusingly abstract terms and used tasks that were too difficult. Researchers have found that young children can achieve success in simpler tasks that require the same skills (Wood et al., 2008). In addition, Vygotsky (1986) argued that Piaget underestimated the role of non-spontaneous concepts, those that are decisively influenced and achieved through instruction, negating the concept of a conceptual system, and failed to identify the interplay between spontaneous and non-spontaneous concepts. From Vygotsky, the development of spontaneous and non-spontaneous concepts is related and constantly interact with each other. In one of his experiments, two children with an intellectual age of eight were tested; one of the children who received instruction completed the task set for a 12-year-old, while the other who did not receive instruction was unable to complete the task set for a nine-year-old, on the basis of which Vygotsky addressed the importance of instruction and proposed a theory of the ZPD, which is defined as the gap that exists between the actual level of achievement found through individual problem solving and the potential level of achievement discovered through adult instruction or collaboration with more knowledgeable peers. In the view of Vygotsky, providing appropriate help will improve performance for students who are in their ZPD.

Piaget's theory, in contrast to Vygotsky's zone of proximal development, holds that the most important source of cognition lies in the individual child himself. Piaget's emphasis is on age appropriateness (Glenn, 2007). From Piaget's (1964) point of view, balance is an essential element of development; it is an active self-regulatory process to help children at all stages of development. This means that when faced with external disturbances, individuals react to compensate. Children assimilate experiences into their own cognitive structures only when they are compatible with existing programmes. If the teaching methods curriculum is not age appropriate and children are not prepared for the content or teaching strategies, they will not learn and there will be no balance (Glenn, 2007). Piaget conducted many experiments to test this theory, such as the red and blue token experiment and the experiment of turning a plastic ball into the shape of a sausage. Thus, Piaget (1964) suggested that learning is possible when relationships and structures develop naturally, rather than through simple external reinforcement, which have been regarded as instructions. In the words of Vygotsky (1986), Piaget drew a sharp line between realistic concepts that children develop primarily through their own mental effort (spontaneous) and

those that are subject to adult deterministic influence (non-spontaneous). However, Vygotsky criticises Piaget's work for ignoring the cultural context in which development takes place (Cole & Wertsch, 1996). He argues that the relationship between the individual and the surrounding culture is one of interdependence. Each person shapes the other and is shaped by the other, and Vygotsky declares that human learning is a social process in which children are socialised and interact with others, confronted with different tasks and challenges, and then assimilate what they have learned into their own knowledge (Top ̧u, 2015). whereas the explanation of how this idea developed remains unclear and largely unknown (Clar à, 2017). For Piaget, however, interaction is seen only as a source of information and not as the essence of the developmental process (Wells, 2001). Vygotsky argues that, although based on our biological inheritance, the ability to act, think, feel and communicate that makes us human depends to a large extent on cultural practices and artefacts and interactions with others through which we adapt and master these practices in a process of goal-oriented joint activity (Wells, 2001).

Building on Piaget and Vygotsky's notion that learning should not be seen as a process of socially shared cognition that ultimately leads to the internalisation of individual knowledge, Lave (1991) argued that constructivist theory limits learning through 'action' or doing tasks in the environment. Learning is neither entirely subjective nor entirely contained within social interaction; Lave argues that learning as a social phenomenon is constituted in the experiential, lived world through legitimate peripheral participation in ongoing social practices, and is a process of becoming a member of an ongoing community of practice. In his work (1991) he uses the example conducted by Jordan (1989) of apprentice learning for Yucatec Maya midwives, where apprentices are peripheral participants who both acquire a broad knowledge of midwifery practice and become increasingly involved in that practice. The apprenticeship may not be considered a teaching job at all, even without teaching, exams and any kinds of tasks, and the Mayan girl who eventually becomes a midwife will master the skill. Learning is given structure and form through peripheral involvement in ongoing activities. The description of the Yucatec midwifery apprenticeship gives us an insight into how learning in practice happens and what it means to move towards full participation in a community of practice. For Lave, social interaction is an important part of contextual learning, and learning does not happen in isolation, but is social in nature (Lave, 1991). However, it has been argued that in some cases situated learning seems to be limited to some ideas and actions of people in a particular space and time, Building on the case of apprenticeships, Lave and Wenger (1991) offered a more comprehensive view of situated learning, arguing that learning can be seen as an evolving set of relationships within a social context, It is a dynamic process that incorporates instruction, support, and re-conceptualization of practice, rooted in everyday activities, contexts and historical cultures, progressing in terms of learner participation. Lave's situated learning offers a perspective on learning that opposes the human-centred cognitive view represented by Piaget in the 1980s and 1990s (Farnsworth et al., 2016).

Piaget’s theory of language and thought has drawn the world’s attention in 1923 (Beilin, 1992). He identified that young children’s speech as egocentric and socialized, and about 45 percent of speech is egocentric at the age of 6 years. In other words, much of children’s speech was said to be for themselves at that stage. Piaget’s work on language provides a window into the child’s process of thought (Beilin, 1992). Piaget and Inhelder (1956)’s three-mountain task also provide evidence for children’s egocentrism. In the task, a child was seated at the table where the three model mountains in front while a researcher placed a doll at different viewpoints of the mountains to test whether the child could identify the viewpoint for the doll. The result showed that children around age four did not distinguish between their own view and that of the doll. However, in 1962, Vygotsky criticised Piaget's view that intersubjectivity which constitutes a necessary condition for normal adult discourse, is not present in the speech of young children, and suggested that all children's speech was social, egocentric language splits from social language in general. From Vygotsky (1962, cited by Hasan, 2002)'s socio-genetic perspective, the development of the child's mentality should first develop from social communication to egocentric speech, which then produces inner speech that enables the child to think aloud, where social communication can be seen as a transmission of emotions, including gestural communication between mother and week-old infant patterns and expressive gestural communication between animals, often associated with needs such as greetings, expressions of dissatisfaction, and demands for attention (Halliday, 1975). Although children can gain some social experience through this communicative behaviour, Vygotsky denied the possibility of inner speech as the first stage of children's language development, in contrast to Piaget's theory of children's language development, which suggests a developmental process from inner speech to egocentric speech and then to socialised language. Furthermore, Piaget's Three Mountains task has been criticised as being too complex and difficult for children to understand. Fishbein et al. (1972) suggest that even three-year-olds can do well if the complex array of 'mountains' is replaced by toys.

Piaget's study of language and thought brought further insights into his theory of consciousness. He linked the

vestiges of egocentrism to a lack of consciousness. This means that the schoolchild is not conscious of his conceptual operations because of egocentrism. In an experiment with simple arithmetic reasoning, young children were unable to explain how they did it, even though they gave the correct answer to the arithmetic problem. In Piaget's (1976) work The grasp consciousness, he related children's inability to explain how they solve problems to the nature of consciousness. However, Vygotsky (1986) argued that deficits in consciousness cannot arise from children's egocentrism but are the product of the non-systematic nature of spontaneous concepts, he argued that a concept must be part of a system and capable of becoming conscious and intentionally controlled. Vygotsky also suggested that school instruction plays a decisive role in making children aware of their own mental processes, whereas Piaget argued that school instruction is the introduction of adult modes of thinking in place of the child's own thinking, which plays no constructive role in the process and is merely replaced by adult modes of reasoning. Piaget's study of the problem of consciousness is therefore a failure because he only emphasises the importance of spontaneous concepts and neglects the importance of non-spontaneous concepts achieved through instruction, negating the concept of conceptual system (Vygotsky, 1986).

Piaget's theories on knowledge acquisition influenced Wells' research work, Piaget believed that knowledge is only truly acquired when it is used by a particular individual in the process of solving a specific problem (Wells, 2001). In addition, Wells emphasises awareness in joint action with others and what is learned and the opportunity for reflection in the process (Wells, 2001). In the process of learning and knowing, students should not be seen as solitary individuals. Nor is awareness a purely individual activity. It depends not only on the mastery of mediating means acquired from other members of the culture, but always occurs in the process of activities carried out with others. Taking dialogue and writing as examples, Wells argues that awareness takes place to a large extent through discourse and that language is not only a mediator of students' engagement with understanding, but also a primary medium for learning and teaching activities. Dialogue involves one speaker immediately responding to another speaker. To make a useful contribution, the speaker needs to make a corresponding effort and reflect. This is also the case with writing, which promotes a more reflective approach and the construction of knowledge. Thus, Wells argues that knowledge is constructed and reconstructed between participants in a given situation, using the cultural resources at their disposal. He emphasises the significance of collaboration. He suggests that collaboration is the most effective way to solve problems and learn. For example, in a teaching experiment to find out which variables affect the speed of a pendulum swing, the length of the pendulum, the weight of the pendulum or the angle of release were the four variables. The group members kept experimenting and recording the results and in the end everyone in the class had a fuller understanding of the function of the pendulum than they would otherwise have had.

Papert's work on constructionism was greatly influenced by Piaget' s constructivism. Piaget's belief that children are constructors of their own intellectual structures and that children seem to be natural learners, having acquired a great deal of knowledge before they go to school, which Papert considered to be 'Piagetian learning' (Papert, 1993b), greatly influenced Papert's research work. Piaget believed that children could learn how to speak and walk in space, which required intuitive knowledge of geometry and did not need to be taught (Papert, 1993b). Beyond this in addition, Papert emphasised the importance of the materials that children need to construct their own knowledge. Among the materials he suggests is the culture that surrounds them. And in some cases, culture provides a great deal of material that can facilitate Piaget's learning. For example, many important things, such as forks, can be materials for building a sense of digital intuition.

Building on Piaget's constructivism, Papert's constructionist theory adds a second construct, one that focuses more closely on mental construction than other educational themes. Papert believes that constructs that occur in the mind are most effective in their construction of knowledge when they are supported by overt constructs in the world. According to Papert (1993a), projects are much more significant than problems and people learn to solve problems and learn new concepts and strategies best when they are actively involved in meaningful projects. For example, when someone creates a skeleton on a screen, he or she can mobilise the whole self: their sense of aesthetics, their sense of what a meaningful project is, their sense of how it relates to who they are as individuals and what values are most important to them. They are creating a project that is rooted in their sense of self, rather than sitting around writing meaningless numbers. In Papert and Harel's (1991) article, Papert cited a project he did at Muzzey Junior School on 'doing lego rather than maths', where students learned maths by sculpting soap models to express their own ways of thinking and ideas of style, which is closely related to the idea of constructivism This is closely related to the idea of constructivism, as it evokes the cognitive activity of learning by making. And certain concepts and ways of thinking that are beyond the cognitive scope of children will spontaneously enter into what they know. This is in line with Piaget's notion of manipulation, which holds

that to know an object is to act on it. To know is to modify and transform the object, to understand the process of this transformation and thus the way in which the object is constructed. Thus, to operate is the essence of knowledge.

Building on constructionism, Papert (1993b) sought to expand the range of activities with learning enrichment, which can enter into learning processes that go beyond specific narrow skills. thus, Papert discusses work on children's use of computers. He recognises that computing technology can greatly expand the range of content and ways in which children can create what are referred to as computer-assisted instruction or CAI (Sawyer, 2014). With computers, children can create things that can move, interact and change over time, such as animations. In the process, children can gain new insights into the workings of the dynamic systems of the world around them, including the workings of their own minds. In addition, computers enable children to modify, copy, record and share their creations in ways they could not before, providing them with new ways of exploring and understanding the creative process. He uses the examples of turtles and drawing to explain how children learn mathematics. Through computer programming, children can move the turtle and make it dance. Very powerful learning takes place in the process of operating the computer and 'talking to the picture or turtle'. Children are learning a language for talking about shapes and shape changes, about speed and rates of change, about processes and procedures when they use the electronic drawing board. They are using these methods to learn mathematics. Furthermore, Papert and Harel (1991) argue that it is important to distinguish between the initial impact of computers on education and the deeper necessity of computer literacy. computer literacy cannot be conceptualised as simply adding new content material to the traditional classroom, but rather as changing the nature of the learning process for students and playing a part in changing the criteria for what knowledge is valued in education. It should also play a role in changing the standards of what knowledge is valued in education. Helping learners have a deeper learning experience, helping them to collaborate or reflect on evolving knowledge (Sawyer, 2014). Computers are not used to program children, but children program computers (Papert, 1993b). In Papert's 1993 work, he suggests that at some point, if individuals are truly engaged in a field of knowledge, they will learn it without a school or curriculum.

Piaget contributed as much as anyone to changing our understanding of children's cognition, and was at the forefront of psychologists concerned with children's cognitive development (Papert, 1999). His constructivist theory of learning refuted the traditional pedagogical model of teacher-driven, student-passive learning by emphasising the importance of construction, arguing that knowledge is constructed by children themselves, and his four stages of cognitive development show us how children's intellectual development moves from the concrete to the abstract. And from a biological perspective, he explained the importance of the subject's own equilibrium and self-regulation in constructing knowledge and moving across stages. His constructivism had a great influence on later teaching and cognition. Papert developed constructionism on his constructivism and emphasised the importance of projects and computers, through which children expand their cognition. Wells, under the influence of his constructivism, emphasised the importance of group work and language, in which children construct and reflect on knowledge in conversational exchanges. Lave developed situated learning based on constructivism, arguing that people construct knowledge on their own in a cultural context, a point Piaget overlooked; furthermore, Piaget did not focus on adult learning, and Lave's situated learning complements the example of adult learning, which is also related to internalisation in Piaget's constructivism. Vygotsky's theoretical work aginsted Piaget’s view of language development and critiqued Piaget's neglect of culture and non-spontaneous concepts. In 1960, however, Piaget's theories became the basis for early education programmes. Although most educators no longer see learners' own construction as the key to learning, Piaget's concept of learners actively constructing their own knowledge based on encountering new information and experiences has taken shape and is presupposed in almost all recent work on learning and development (Wells, 2001). It has been widely accepted that knowledge is not passively received through sensory or communicative means but is actively constructed by the cognitive subject (Glasersfeld, 1995).

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