歷史分析教育心理學的源起與發展

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摘要

　　關於教育心理學的源起的課題歷來都在學界引起廣泛爭論。一部分學者認為教育心理學的源起可以回溯至人類文明的源起。這些學者認為最早的教育心理學概念起始於人類教育撫養子女的天性中。然而另一部分學者認為，教育心理學的源起可以回溯於古希臘的哲學理論。本文試圖從有證可考的歷史中分析教育心理學的源起以及其最終發展為跨學科領域理論的過程。

關鍵字：歷史分析，理論發展，教育心理學。

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Historical Review of Educational Psychology as a Contextual Science Educational Psychology Evolved over Time

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Abstract

For years, there are various discussions about the origin of educational psychology in the field. Some researchers believe that educational psychology has a long history as we human being trying to educate their offspring to survive. Others believe that educational psychology emerges from ancient philosophy ideas. This article reviewed the topics that educational psychologists have studied over time and the methodologies that they have employed to define educational psychology.

Keywords: historical review, theories, educational psychology

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The recorded root of educational psychology in history may begin with the ancient Greek philosopher Aristotle and his book *De Memoria et Reminiscentia* (On Memory and Reminiscence, translated by Beare) in 350 B.C. As he noted:

> Memory relates to the past…at the very individual and concluding instant when first (the sensory experience or scientific knowledge) has been completely implanted, there is then already established in the person affected the (sensory) affection, or the scientific knowledge (if one ought to apply the term "scientific knowledge") to the (mnemonic) state or affection; and indeed one may well remember, in the "incidental" sense, some of the things which are properly objects of scientific knowledge; but to remember, … is an activity which will not be immanent until the original experience has undergone lapse of time. For one remembers now what one saw or otherwise experienced formerly; the moment of the original experience and the moment of the memory of it are never identical. (Beare, 2008, p. 4)

This description might be the earliest recorded evidence on human consciousness dealing with the relation of memory, retention and learning. Juan Luis Vives is another influential philosopher who offered brilliant thoughts about applying psychological ideas to educational practices. In his book *De Tradendis Disciplinus* (Vives, 1531; translated by Watson 1913), Vives emphasized that factors such as practices, biological maturation, and self-evaluation are important during the learning process (Vive, 1531; Charles, 1976; Berliner, 1993; Weinstein & Way, 2003). Although these ideas were published hundreds of years ago, they would sound familiar to the modern educational psychologists.

Behavioral Era-Emergence of Behavioral Psychology

Prior to the 20th century, theorists struggled to find a valid method to further investigate intangible human minds. However, studies on human consciousness lead to vast criticism on the validity and reliability of investigations and conclusions. The most prominent criticism was the Comte's paradox to the prevalent method introspection: "how one and the same organ be the organ doing the observing and the organ being observed" (Nelson, 1996, pp.104). The emergence of behaviorism tried to circumvent the unobservable mental states and focused only on observable behavior change. Beginning with the efforts of Ivan Pavlov (*Classical Conditioning*) and Edward Thorndike (*Instrumental Conditioning*), behaviorism dominated the psychological research for nearly half century in United States (Ormrod, 2008).

Topics in Behavioral Psychology

The idea of classical conditioning was originally proposed by Ivan Pavlov (1849 – 1936) to explain the process of acquiring involuntary responses through repeated process of the stimulus-response association. The influential book *Conditioned Reflexes* (written by Pavlov in 1927) made great contribution to experimental psychology in early 20th century. Many of Pavlov's devoted followers replicated his experiments using other stimuli with other responses across species and demonstrated that classical conditioning could be applied into many species such as lab rats, or human infants. For example, Watson and Rayner (1920) showed an unemotional infant could be conditioned to fear white rats and such negative reaction could be transferred to everything that shared same characters with a white rat, such as Santa Claus mask, a white fur coat, a rabbit, and Watson's hair. Jones (1924) demonstrated how to eliminate involuntary fear to rabbits by overpower the fear with a new and stronger response through classical conditioning procedures. Those attempts showed that involuntary responses elicited by classical conditioning are universal and that human beings exhibit similar learning paths as do animals. Thus, behaviorists believed that the learning process and learning outcomes observed from animals could be generalized to human beings. From a behavioral perspective, the ideas of classical conditioning

can be effective in educational settings. First, they believe that actively-practiced learned information is essential during the learning practice. Second, it is important to help learners build positive associations between the learning subject and pleasant emotions during the learning procedures. Third, when dealing with undesired behaviors, teachers or educators must introduce a more productive S-R connection to replace existing one.

Instrumental conditioning, the other branch of behaviorism, focused on voluntary learning behaviors aroused by reinforcement, which was first proposed by Edward Thorndike (1874 – 1949) and further developed by Burrhus Frederic Skinner (1904-1990). Thorndike believed learners build connections between a stimulus and response based on their previous attempts or practices. Once the consequence of the behavior, like success or failure, satisfaction or annoyance, and reward or punishment, is connected with the experience, the influences would be reflected by the frequency rate of performing that behavior (Charles, 1976, Berliner, 1993). In short, behaviors connected with promising consequences are increased while behaviors connected with unpleasant consequences or futile attempts are decreased.

Skinner further developed the "reward" part of Thorndike's law of effect and created the term operant conditioning. Different from Thorndike, in operant conditioning Skinner replaced reward by introducing *reinforcer* to describe the consequence that influences the probability of a response. Skinner claimed that *reward* is not a proper word, because it only emphasized a stimulus or an event leading to pleasant and desirable consequence. However, people sometimes tend to continue a behavior that is not pleasant to others (Ormrod, 2008). Skinner claimed behavior that is reinforced is more likely to be repeated, whereas behavior that is not reinforced tends to be inhibited.

Over years, instrumental behaviorists offered a number of valuable suggestions on using reinforcement to guide students' behavior, which are still valid in today's classrooms. Behaviorists recommend teachers describe the end result clearly, specifically, and concretely at the very beginning. By doing this, students then have clear idea regarding the desired behaviors and can evaluate their progress. Then, behaviorists recommend that intrinsic reinforcement is more

productive in helping students engage in certain tasks, whereas extrinsic reinforcement only works when a desired behavior cannot occur on its own. More importantly, whenever a reinforcer is used, it must be truly reinforcing to the learner.

However, with further development of the behavioral approach, several drawbacks elicited great criticize in the field: (a) the very artificial conditions controlled by the experimenters do not reflect the real world situation; (b) using animals as main test subjects limits the implications of the findings to human beings; 3) the observations to animal's behaviors only reveal learning on lower-level skills. Even Watson, as a strict experimental psychologist, raised the notion of human consciousness. As Watson mentioned:

> "What is bearing of animal work upon human psychology?" I used to have to study over this question. Indeed it always embarrassed me somewhat. The enormous number of experiments which we have carried out upon learning have likewise contributed little to human psychology (Watson, 1994, p. 248). The situation is somewhat different when we come to a study of the more complex forms of behavior such as imagination, judgment, reasoning and conception (Watson, 1994, p. 252).

Cognitive Era-Emergence of Cognitive Psychology

Some researchers believed cognitive psychology emerged since 1960s (O'Donnell & Levin, 2001; Ormrod, 2008); others viewed the rise of cognitive psychology as a revolution that went back to address central issues of human minds, which had been interrupted by behaviorism in the 20th century (Mandler, 2002; Miller, 2003). There was no identifiable event to show the shift from behaviorism to cognitivism. It just happened gradually as more and more cognitive variables were being considered in the field. "Stimulus-response behaviorism was not violently displaced, rather as a cognitive approach evolved behaviorism faded because of its failure to solve basic questions about human thought and action, and memory in particular" (Mandler, 2002, p. 339).

Topics in Cognitive Psychology

Over years of systematically investigating human consciousness, cognitive psychology had incorporated research in many different areas such as memory, motivation, beliefs, instruction, neuroscience, technology, strategies and so on. It is difficult to draw a sharp line to differentiate various perspectives in cognitive psychology because these theories are interrelated with one another. Together, they make great contribution to understand human thinking and learning. Topics such as social cognitive theory, constructive theory, information processing theory, and metacognitive theory show the emergence and development of cognitive psychology.

Social Cognitive Theory.

The development of social cognitive theory blended pure behavioral concepts with cognitive ideas together, which reflected changes in the field in the middle of 20th century. The central idea of social cognitive theory is that learning occurs in a social context. By observing, imitating, and modeling another's behaviors or outcomes, human beings acquire useful knowledge and perform certain behaviors in a social environment.

Bandura, as an influential theorist, should be discussed in social cognitive theory. He believed that behavior changes were rooted deeply in human consciousness. In other words, learning will not occur unless the individual has awareness of the stimulus-response contingencies (Bandura, 1971; Ormrod, 2008). According to Bandura, the individual first build symbolic representations of the observed behavior in his mind. Then, he has to retrieve the symbolic representations and replicate the behavior in actual practices. Bandura defined this process as modeling, which is considered to be an effective method to acquire behaviors, mores, languages, beliefs, attitudes and so on.

Motivational factor is another incentive for the individual to perform or behave like what he/she has observed (Bandura, 1977; Ormrod, 2008). An individual is motivated to imitate a behavior or to increase the frequency of a behavior if the behavior he/she observed is reinforced, performed by a competent individual, related to their own situation and so on (Bandura, 1977; Ormrod, 2008). Later on, with the development of the social cognitive theory, more factors, such

as self-efficacy and self-regulation, have been involved in the theory. Studies have shown that as children grow up, they gradually learn to set a standard to discriminate acceptable and unacceptable behaviors and they learn to evaluate their own behaviors based on that standard (Bandura, 1977; Bandura & Kupers, 1964). The source of self-regulation can be traced from both direct experience and indirect experience in one's life. Self-efficacy, which represents one's believe in his/her own capability of completing a task, is "a major determinant of self-regulation" (Bandura 1977). Studies have shown that individuals with high self-efficacy are more likely to choose challenging tasks (Bandura 1993), to set higher goals (Bandura et al., 2001; Zimmerman et al. 1992) and to persist when they encounter obstacles (Shunk & Pajares, 2004). Thus, individuals with high self-efficacy are more likely to succeed.

By addressing the reciprocal causes within environmental factors, cognitive factors and behavior changes, social cognitive theory can be implemented in a wide range of educational practices. First, cognitive capacity enables human beings to anticipate possible consequences from indirect experiences as well as from direct experiences. From observing other's behaviors, learners can build S-R contingencies entirely based on indirect experience and they can predict the consequences of that behavior before they actually do it. Second, modeling is effective in introducing new skills. However, modeling is not restricted to imitate only desired behaviors in class. Undesired behaviors, beliefs, attitudes, and values can be imitated as effectively as the desired ones from teachers and other social members in and out of class. Therefore, responsible adults need to make sure that we are not setting bad models to our children. Finally, it is important to help learners have a strong faith in their abilities to complete a given task. Only when learners have high self-efficacy are they willing to choose more challenging tasks, setting higher goals, make more efforts and be more persistent when they encounter obstacles.

Motivation.

Motivation is another theory that combines concepts from both behavioral psychology and cognitive psychology. Motivation theorists believe that motivation is rooted in operant conditioning in which different types of reinforcers

were identified and tested (Skinner 1953). But motivation is also embedded in human cognition influenced by wills and needs. To explain, behavioral theorists quantified motivation as an increased level of responding generated by reinforcers or rewards. Whereas, cognitive theorists believed that besides the external reinforcement, the power of inner forces, such as interests, beliefs, wills, may affect motivation as well. Therefore, motivation theorists divided motivation into extrinsic motivation and intrinsic motivation. Extrinsic motivation "exists when the source of motivation lies outside of the individual and the task being performed" (Ormrod, 2008, p. 454). For example, I would clean my table only when I realize that there is no more space to put things on it or when something I need might be buried deeply in the stack. In contrast, intrinsic motivation "exists when the source of motivation within the individual and task: The individual finds the task enjoyable or worthwhile in and of itself" (Ormord, 2008, p. 454). For instance, my mom loves to keep everything right in its position. She can spend all day long leaning and organizing her stuff. She just can't resist her desire to keep clean, but soon after she cleaned my table, I can't find my messy-organized materials. Therefore, motivation theorist believe that intrinsic motivation is the optimal status and that learners with intrinsic motivation will be more concentrated on tasks, be more persistent when they fail, be more likely to select challenging tasks, and be more interested in seeking true understanding. Extrinsic motivation can be effective in promoting successful learning and productive behaviors but it has its drawbacks as learners may engage in only minimal efforts they need to complete a task, and learners may quit an activity once the reinforcer disappears. For instance, I always mark *very satisfied* on my questionnaire in *Café Grazie*, even when sometimes I am not that satisfied with one or more dishes. I do so simply because filling out the survey brings me nice coupons for my next visit and marking very satisfied enables me to skip listing reasons in detail. If there are no coupons, or the coupons are not what I want, I would never worry about that survey and just leave it blank. However, such drawbacks should not prevent application of extrinsic motivation methods during instruction. On many occasions, learners can be motivated both extrinsically and intrinsically. Hence learners have little interest on certain tasks using extrinsic motivation can be more

effective than using intrinsic motivation.

Over years, based on various perspectives dealing with human needs, motivation is viewed as an influential part of learning theory. The early drive reduction theorists believed that a drive within an individual was responsible for a behavior change. This theory emphasized the relationship between fulfilling needs and maintaining performance rate: Once a need was deprived, physiological homeostasis lost equilibrium. A drive existed until the need was satisfied. The idea was not difficult to understand, but it took years for motivation theories identify different human needs and specific influences. Hull (1943, 1951) proposed that human beings have four basic needs: hunger, thirst, sex and avoidance of pain. All those basic needs formed the physiological homeostasis within an individual. In addition to the four basic needs, theorists also expended the needs list as 18 basic needs (Mcdougall, 1932), 20 psychogenic needs (Murray, 1938) and Maslow's hierarchy of needs (Maslow, 1945). In those works, these theorists offered more specific definitions and descriptions of physical needs (e.g., food, water, oxygen), and psychological needs (e.g., safety. self-assertion, belonging, attention). Later, Hull (1951) revised his ideas by adding incentive into his theory to show the influence of goals; that as a goal was fulfilled, the incentive to behave gradually decreased and hence the strength of behavior decreased. He concluded that a behavior is not exhibited when any of three factors – habit strength, drive, or incentive – is absent. Later, this idea was developed to incentive motivation that "goal object serves as a mediator between stimuli and response, affecting which stimuli are responded to and which are not" (Ormrod 2008, p. 456).

Research on motivation has numerous implications for creating a motivating classroom environment and promoting learning and achievement. For example, learners are better intrinsically motivated so they can learn more effectively. Only when learners perceive learning as in their own interest will they be willing to spend more time and energy on their tasks and to engage in more productive activities. Extrinsic motivation method can also promote learning outcomes, but it should be used only when it is necessary. The misuse of extrinsic motivation may decrease the intrinsic motivation. Finally, class assessment should not only focus on scores from rigid high stake tests. Instead, multiple forms of

assessments should be employed in classroom activities.

Constructive Theory.

In the early 20th century, while behaviorism dominated the psychological research in United States, constructive theory, which was interested in child development, emerged quietly in Europe. Piaget and Vygotsky had great impact on framing contemporary constructivism, but their studies didn't gain much attention until they were translated into English in 1960s.

Piaget's Individual constructivism. Piaget is the pioneer in individual constructivism. He believed that children hemselves are capable of building increasingly complex understanding through their interactions to the social environment along with their biological maturation. In his theory, schema, as groups of organized thoughts and behaviors, is an important term that is being emphasized repeatedly. As children grow up, they consistently build schemas based on their experiences of interactions with the environment. Each time, when a new object or event is encountered, two processes occur: (a) When the object or event fits to an existing schema the object or event is integrated to the schema. For example, once a child builds a schema for addition, he/she may use this schema to deal with all situations involving additions like 7+5=12, or 56+28=84. Piaget named this kind of process as assimilation. (b) When the object or event does not fit to an existing schema, the schema would be either modified to include the new object or event, or an entirely new schema would be constructed to deal with the new object or even. For example, when the subtraction problems cannot fit to a schema for addition, the child would either integrate subtraction in the schema for addition by treating it as an inverse operation of addition like x+5=12, x=7, so 12-5=7, or build a completely new schema for subtraction like 12-5=7. Piaget named this kind of process as accommodation. According to Piaget, while children are interacting with the outside world, children consistently build new schemas, practice existing schemas, and modify schemas to deal with situations they encounter. With assimilation and accommodation, children gradually learn to construct and evolve their own schematic systems (cognitive structure) to solve problems or deal with various situations sophisticatedly and elegantly.

Piaget divided the cognitive development into four stages based on

children's biological maturation. Sensorimotor stage (birth – 2 years old) is the period that children can build schemas primarily based on their own perceptions or behaviors while they interact with the environment, hence the main feature of this stage is egocentricism – "an inability to view situations from others perspective" (Ormrod, 2008, p. 314). In sensorimotor stage, with repeated observing and practicing, children are capable of building simple version of cause-effect relations (goal-direct behavior), symbolizing objects and events in their minds (symbolic thought) and imitating behaviors based on recall. In preoperational stage (2 – 7 years old), with the further development of symbolic thoughts and vocabulary base, children are able to think and talk beyond the immediate events and form "logical" reasoning, even though such logical reasoning sounds more illogically from an adult's standard. "The child's thinking depends more on perception than logic during the preoperational stage and so is susceptible to outward appearance (Ormrod, 2008, p. 316): the beads are colored differently and so they must be different." The ability of logical reasoning is still restricted by egocentric features. However, children start to struggle with self-centering and conservation in preoperational stage. When moving to concrete operation stage (7 – 12 years old), children are capable of conservation, that is, they are aware that if nothing changes in quality or quantity of an object, the object stays the same: the wooden beads are same despite the fact that they are colored differently. However, children in this stage can only form valid logical reasoning on concrete objects and reality-based situations. After entering formal operation stage (12 – adulthood), children are able to reason logically beyond physical reality. They can think logically on abstract concepts, hypothetical ideas and contrary-to-fact statements (Ormrod, 2008). Children are capable of employing more cognitive strategies to develop complex and sophisticated understanding to the world. However, Piaget's theory is not universally accepted. Researchers argue that he probably underestimated the capabilities of preadolescent children. Children can behave beyond their stage, such as acquiring complex skills, engaging in conservation, or thinking abstractly once prerequisite requirements are fulfilled (Gelman & Baillargeon, 1983; Metz, 1995).

Vygotsky's Sociocultural Theory.　Instead of emphasizing on individual's

efforts, Vygotsky believed that sociocultural environment fosters cognitive development. Therefore, Vygotsky argued that cognitive development couldn't be seen as constructions fully created by an individual based on his/her own understandings. Rather cognitive development had a historical and cultural root that could be traced. Therefore, in his work Vygotsky emphasized on the importance of factors such as informal conversations between adults and children, formal education, and social interactions.

Vygotsky developed concepts of cognitive learning zones, known as the zone of proximal development (ZPD), which had profound influences in areas of teaching and learning. The ZPD means the gap between what the learner can currently achieve independently and what the learner cannot currently achieve independently. The central idea of the zone of proximal development is that learners can learn more effectively when they are supported by others on tasks that are challenging enough but not frustrating or frightening to learners. As the extension of the ZPD, the notion of scaffolding (Wood et al., 1976) as a collective body of various techniques to help students accomplish challenging tasks has been incorporated as effective instructional strategy to help learners acquire knowledge during learning process.

Driven by the belief that learners actively construct their understandings from their experiences, constructive theory also focuses on exploring human memory, but it does so from a slightly different perspective than does information processing theory. Instead of acquiring information directly from the environment, people actively construct knowledge by organizing or making sense of the information they acquired. Therefore, little by little, people construct an expandable knowledge database in their minds, which not only enables them to store information more effectively, but also decrease the possibility of forgetfulness. The central idea of constructivism, that learners themselves must perform actively with all necessary means to acquire information, is influential in the application of cognitive principles to classroom activities. For example, information learning in a rote manner decays quickly so that fifth graders can hardly recall historical policies based on mechanical rehearsal (Beck & McKeown, 1994). Therefore it highlights the need for meaningful learning. Methods such as

activating prior knowledge, using concept maps, and encoding with visual aids are considered to be effective in provoking meaningful learning. Prior knowledge means the knowledge stored in a learner's long-term memory that is available to make connection with new material. Learning is shown to be more effective when the newly acquired information connects with prior knowledge and individuals with higher level of prior knowledge learn better (Schwartz & Bransford, 1998; Surber & Schroeder, 2007). Concept maps, as a graphical representation of knowledge, consist of a set of nodes representing concepts, objects, or actions connected by directional links that define the relationship among these nodes. A concept map is compressed visual patterns and relationships that help students to clarify their thinking, and to process, organize and prioritize ideas effectively. Individuals learn better with the help of concept maps (Wang & Dywer, 2006; Zheng & Dahl, 2010). The major drawbacks of constructivism are: 1) it only offers vague explanations on learner's cognitive process 2) it ignores teacher's influences over individual's learning activities (Ormrod, 2008).

Information Processing Theory.

The development of information processing theory is embedded in early attempts to portray human learning activities in 1960s. There is a consensus that three structural components, sensory memory, working memory, and long-term memory, are involved in the memory system. Early researchers used a computer analogy to describe the information processing procedures in the human mind. Although such an analogy is too simple or too rigid to reflect the complex mental processing procedures, it is helpful to illustrate structural features of the memory system. Atkinson and Shiffrin (1966, 1968) built a fundamental framework for studying human memory. In the Atkinson-Shiffrin's model, input referred to any kind of information in the environment that can be seen, heard, smelled, or touched. The received information fades quickly in sensory memory unless the information is further processed (e.g., attention, encoding, rehearsal, and retrieving strategies) and stored appropriately.

Information is held in the same form as it is been sensed, so it is not yet seen as encoded information. One experiment on testing the duration of visual register

was done by Sperling (1960). He noted that sensory register could hold most of information that was received from a visual display, but it faded quickly after about 0.5 second. Unlike the visual register, studies on auditory register showed information stored in auditory form could last longer: information was lost in 4 seconds (Darwin, Turvey, & Crowder, 1972). Working memory is a modified term on original notion of short-term memory in the Atkinson-Shiffrin's model. Besides the storage function, working memory also emphasizes the function of the central executive process, which suggests that thinking occurs in the memory system while it stores information. Working memory plays an essential role in information control and regulation. It stores and processes information that is delivered from the sensory register. Meanwhile, it also holds and processes information that it retrieves from long-term memory (Baddeley, 1992; Miyake & Shah, 1999). Two studies helped to portray working memory duration and capacity. Peterson and Peterson (1959) quantified the duration of working memory in their experiments, which showed people were able to recall 80% of information after 3 seconds of delay, but the accuracy rate dropped dramatically to approximately 10% in 18 seconds. Based on the results, researchers believe that working memory can hold information for about 20 seconds without further cognitive processing. George Miller's (1956) *magical number seven, plus or minus two* is another classic work on the limited capacity for information processing. Miller argued the capacity of working memory is located "somewhere in the neighborhood of seven," but the capacity can be expanded by "grouping or organizing the input sequence into units or chunks" (Miller, 1956, p. 90). Even though the number of information units is fixed in 7±2, the amount of information in each unit can be increased. By building larger units, working memory can hold more information than before.

Long-term memory is the final stage of the memory system. Unlike sensory memory and working memory, which focus on recent events or experiences, long-term memory is more sophisticated in that it involves memory traces back over periods of days, weeks, months, and years. As the word *long*-shows, long-term memory refers to information stored permanently in human minds. Researchers believe that the capacity and duration of long-term

memory is believed to be unlimited and permanent and that *forgetting* is due to unsuccessful information retrieval.

Information processing theory made great contribution to understanding how people deal with the information they acquired and how information is processed mentally. The weakness of information process theory is that it "has yet to combine various cognitive processes into an integrated whole that explains, overall, how human beings think and behave" (Ormrod, 2008, p. 64). Recent years, some alternative theories have attempted to deal with the weakness of information processing theory. One alternative theory is levels of processing model of human memory that was developed by Craik and Lockhart (1972) who argued information is processed at different levels simultaneously. The length of the information duration and the quality of the information retention are dependent on whether the information is being *deep* processed. The model itself has some impact on studies of learning and memory. However, the concept of deep processing is too vague to be defined or measured precisely.

Metacognition.

Metacognition is "thinking about one's own thinking" (Flavell, 1979). During the past four decades, metacognition has been systematically investigated as one of main topics in cognitive psychology. This theory incorporates various concepts in cognitive psychology such as cognitive processing, developmental factors, social context factors, and motivational factors. Two influential articles were essential for the growth of metacognition as a new school of psychology. One cornerstone in the field is the article, *Metacognition and Cognitive Monitoring: A new Area of Cognitive Development Inquiry*, published by John H. Flavell in 1979. In this article, Flavell proposed basic definitions in metacognitive theory and emphasized the importance of metacognitive process on child development and human behavior in general. The concepts and ideas mentioned by Flavell in 1979 are still influential to the modern-day research in metacognition. Based on his great contribution to the growth of the metacognitive school (Dunlosky & Metcalfe, 2008), Flavell is titled as "father of metacognition". The other remarkable footnote to the development of metacognition is Nelson and Narens' framework published in *Metamemory: A Theoretical Framework*

and New Findings in 1990. In their framework, Nelson and Narens (1990) systematically illustrated monitoring judgments and control process, and their relationships with three stages of learning. This is the first time that the past fragmented research on metacognition and information processing was unified and fitted under a large framework work.

Studies in metacognition deal with learners' self-monitoring and self-control mechanisms during the learning process and they are further expanded to address learning issues such as self-regulated learning and age-related factors affecting metacognitive processes. The general model of self-regulated learning (SRL) is expanded upon by Winne and Hadwin's model. The general SRL model provided a framework about how various factors such as motivation and knowledge domain can be included into memory achitecture and where together they afftect cognitive processes that may lead to different behaviors and end states. The model itself is inherently complicated and it will be more complicated if the recursive nature of learning process is taken into account. Therefore, it is not easy for researchers to investigate self-regulated learning. Instead, just like doing a jigsaw puzzle, by combining findings got from each sub-area under the SRL model, researchers are able to form a more comphrensive piscture about self-regulated learning. For example, the existing body of research shows that people are poor at estimating their knowledge on various situations (Barnett & Hixon, 1997; Bol & Hacker, 2001; Bol, Hacker, O'Shea, & Allen, 2005). Evidences showed learners' beliefs about their abilities to success at a given task are as influential on their performance as their actual abilities, because learners with higher self-efficacy are more likely to monitor their learning progress, apply various strategies and regulate their learning process in an effective manner (Bandura, 1977; Chemers, Hu, & Garcia, 2001; Robbins et al., 2004). The development of *Cognitive Process Model* (Flower & Hayes, 1981) in specific domain of *rhetoric and composition* emphasized, "writing is best understood as a set of distinctive thinking processes which writers orchestrate or organize during the act of composing"(Flower & Hayes, 1981, p. 366).

Defining Educational Psychology

Educational Psychology is formed by two words: education and psychology. Based on the explanation offered by Oxford Dictionary, the word *education* is defined as "the process of receiving or giving systematic instruction, especially at a school or university." The word *psychology* is formed by psyche and logy. Psyche means human mind or soul, whereas logy means study. Therefore, the Oxford Dictionary defines it as "the scientific study of the human mind and its functions, especially those affecting behaviors in a given context." Based on the explanation of each word, the definition of educational psychology is a series of scientific studies on human minds and behaviors in an educational setting. In other words, educational psychology is the application of psychological principles in the education field, which aims to find effective methods for helping learners acquire knowledge more efficiently. In particular, it is a distinct discipline concerned with human behavior changes, human cognitive processes, human personality, biological and cognitive development and effects of social interaction in education environment.

Educational Psychology Evolved as Distinctive Contextual Science

In modern explanation, science refers to "intellectual and practical activities encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment" (Oxford Dictionary). Although insights from ancient philosopher-educators offer valuable resources to establish the basic ideas of educational psychology, it cannot yet be viewed as distinctive science. The ancient thoughts were based entirely on random observations and personal experiences from educational practices. No empirical evidence could be traced in ancient times. Furthermore, those thoughts were embedded in history of western philosophical beliefs which were only a byproduct of philosophical attempts. Educational psychology was not able to distinguish itself from western philosophy.

In the late 18th century and the 19th century, psychologists added science to their psychological research to distinguish psychology from philosophy. Johann Friedrich Herbart made a remarkable contribution by incorporating empirical

science in psychological studies and by introducing mathematical methods into psychological research (Charles, 1976; Weinstein & Way, 2003). Later, in the 1870s, Wilhelm Wundt published the first handbook of experimental psychology and founded the first formal laboratory in Germany. Wundt applied scientific introspection as a primary method to analyze human mind and tried to distinguish psychological concepts from philosophical beliefs. However, Wundt emphasized that experiments were not feasible to higher mental processes such as learning process. Instead, he argued that mental activities must be studied through techniques of historical and naturalistic observation and also of logical analysis (Blumenthal, 1975). Restricted by the historical beliefs, in the 18th and 19th centuries, most mainstream educators had strong religious backgrounds and they did not believe that the human mind could be measured in a scientific manner. The "scientific" studies in this time period could not be done in as truly an objective or experimental manner as is done today. Despite the fact that a large number of early psychological studies were done via introspection, educational psychology was not able to distinguish itself from philosophy and be established as an independent science.

The emergence of behaviorism signaled the beginning of establishing theories in educational psychology: abundant empirical evidences were collected using scientific methods. For most behavioral studies, the subjects were tested in a strict controlled experimental environment and findings were based entirely on objective observations. For example, in Pavlov's experiments, in order to observe the salivation response more objectively, Pavlov put the dog into immobile position, made a surgical incision in the dog's mouth, and built a special experimental device to make salivation more observable and measurable. In Thorndike's puzzle box and Skinner's box, hungry animals were trapped in a box in which reinforcers were only delivered when the certain devices was appropriately manipulated. As a strict experimental psychologist, Skinner wrote in 1953, "When we come to refine the notion of probability of response for scientific use, we find that here, too, our data are frequencies and that the conditions under which they are observed must be specified. The main technical problem in designing a controlled experiment is to provide for the observation and interpretation of frequencies. We eliminate, or at

least hold constant, any condition which encourages behavior which competes with the behavior we are to study" (Skinner 1953, p. 63). This could be the earliest description on how to conduct a scientific research systematically on learning response in a controlled experimental setting. The idea of eliminating variables, holding constant in a controlled experiment, and interpreting the quantities objectively are still true in today's experimental procedures. Starting from the behavioral approach, studies in educational psychology become truly distinctive by examining variables concerned with learning activities. Theories such as classical conditioning and instrumental conditioning were finally established and supported by an abundance of empirical data which were collected in strictly controlled experimental environments with scientific measurements (e.g., drops of salivation, probability of response, frequency of responses, or lab notes on behavior changes).

From the late 19th century, with topics involving the cognitive approach, the research paradigms in educational psychology were finally fully established. This set educational psychology as a distinctive contextual science on investigating the nature of human learning activities both in laboratory and in field.

Research Methodologies and Thorndike's Science of Education

The research methodologies in educational psychology can be classified into two main categories: qualitative methods and quantitative methods. Qualitative methods focus on answering questions like *why* and *how*, which provides an in-depth understanding regarding a behavior in a particular time (Merriam, 2001). Quantitative methods gather numerical data focuses on looking at cause-effect relations and make predictions. Researchers are allowed to select research methods based on their own need. For example, Piaget and Vogasky examined the development of children's reasoning ability through dialogues during series of experiments. Wimmer and Perner (1983) investigated children's understanding of false beliefs by asking children to solve the problems proposed

in a scenario. There are also many studies that involved the use of statistics. For example, the gamma correlation is used to measure relative accuracy of knowledge monitoring ranging from -1.0 to +1.0 (Leonesio & Nelson, 1990; Korait, 1997). Scores on achievement tests are used to measure effectiveness of instructional methods (Mayer & Sims, 1994; Mayer, 2002; Huk, 2006). The evolution of methodologies employed in educational psychology fulfills Thorndike's assumption of science of education. As Thorndike believed, "whatever exists exists in some amount" (Thorndike, 1913, p. 142). Thus, Thorndike, "more than any of other educational psychologists, sponsored statistical method, redevised it for a hundred variable types of inquiry, taught it to his students and headed with a professional associate or two, the whole movement to give educational thought and practice a scientific and dependable technique" (Suzzallo, 1966, p. 459). No matter which method is chosen, the established research paradigms make the research findings universally understandable.

With years of systematically investigating human consciousness and supported by abundant empirical evidences, educational psychology has become an interdisciplinary contextual science that expanded to cover at least six disciplines: psychology, linguistics, neuroscience, computer science, anthropology, and philosophy (Miller, 2003). The established theories in educational psychology enlighten researchers from other areas to form alternative ideas. For example, Krashen proposed the importance of *i+1* during second language acquisition. Flower and Hayes proposed *cognitive processing model* emphasizing the importance of cognitive process during composition. Meanwhile, by incorporating concepts from other areas, educational psychologists are able to solve existing problems and face newly emerged ones as well. For example, neuroscientific research helps educational psychologists explain how information processing is associated with different areas of the brain. Multimedia learning environment offers more cues for students to encode information, but may lead to cognitive overload by presenting vast amount information in relatively short period of time. Therefore, nowadays, educational psychology has become an independent discipline that deals with all issues related to human learning activities.

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