
Learning in adulthood: Through the metacognitive lens

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Abstract

Metacognitive learning has been mostly studied for populations consisting of children, and only a limited amount of metacognitive research is dedicated to adult learning. This paper aims to study metacognitive approaches and strategies for adults. This research summarized and analyzed 10 academic articles regarding the metacognitive learning strategies that increase the capacity to learn in human adults. The population considered for this review were adult university students. The criteria of inclusion for this research consisted of: articles that were published in the last five years, articles published in peer reviewed journals and research that articulated the results and conclusions of original research relating to metacognition learning strategies in adult students. The general results derived from the research papers that were reviewed suggest that there are a variety of teaching approaches and learning styles among adults that affect learning, and that there are both external and internal factors that can also affect adult learning through metacognition. In conclusion, it was found that these factors should be weighed in and considered when designing a learning program for adults and that more metacognitive research should be made with the adult population.

Keywords: Adult learning, Metacognition, learning strategies, learning capacity

Resumen

El aprendizaje metacognitivo se ha estudiado principalmente para poblaciones compuestas por niños, y sólo una cantidad limitada de investigación metacognitiva es dedicada al aprendizaje de adultos. Este trabajo tiene como objetivo examinar los enfoques y estrategias metacognitivas para adultos. Esta investigación resume y analiza 10 artículos académicos sobre las estrategias de aprendizaje metacognitivo que incrementan la capacidad de aprendizaje en adultos humanos. La población considerada para esta revisión fueron estudiantes universitarios adultos. Los criterios de inclusión para esta investigación consistieron en: artículos publicados en los últimos cinco años, artículos publicados en revistas revisadas por pares e investigación que articularon los resultados y conclusiones de la investigación original relacionada con estrategias de aprendizaje de metacognición en estudiantes adultos. Los resultados generales derivados de los trabajos de investigación que se revisaron sugieren que hay una variedad de enfoques de enseñanza y estilos de aprendizaje entre los adultos que afectan el aprendizaje, y que hay factores externos e internos que también pueden afectar el aprendizaje de adultos a través de la metacognición. En conclusión, se encontró que estos factores deben ser sopesados y considerados al diseñar un programa de aprendizaje para adultos y que se debe realizar más investigación metacognitiva con la población adulta.

Palabras claves: Aprendizaje de adultos, metacognición, estrategias de aprendizaje, capacidad de aprendizaje.

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Introduction

It is unequivocal that the learning process between adults and children have distinct characteristic differences that continue changing throughout an individual's lifespan (Zwart, Vissers, Kessels, & Maes, 2019). As a result, the methods, practices and strategies invested in researching the learning process of both populations differs. Among the vast amount of literature that is dedicated to human learning, this paper will focus on reviewing research that is pertinent adult learning, and specifically, analyzing the role of metacognition in adult learning.

One of the differentiations that exists between adults and children are their physiological differences. Some of the differences are that children and adolescents undergo critical and sensitive periods of learning and development, they experience structural brain changes through brain maturation, and their cognitive process develops over time, while adults already have a mature brain (Paus, 2005). However, both adults and children experience changes in their brain structure through brain plasticity (Cajal, 1991; Garland & Howard, 2009).

Another differentiation that affects the learning process of adults and children emerges from external factors that relate to how and why adults (andragogy) and children (pedagogy) learn. Knowles (1984) presents a five-factor learning process model where pedagogy and andragogy are contrasted. This model suggests that: 1) while the pedagogical approach places the learner as teacher-dependent, the adult learner is self-directing (but conditioned by the schooling approach). 2) For a child, identity comes from external sources rather than from experience, while adults are naturally experienced (but may be locked into specific thinking models). 3) A young students' readiness to learn is age dependent, where-as the readiness of an

adult is dependent on the "need to know". 4) In pedagogy orientation to learning is subject-centered, while in adults its problem-centered, and lastly, 5) in pedagogy, learning is reinforced through external motivation and lacks the internal motivation drive present in adults.

Considering that metacognition, which can be defined simply as the cognition about cognitive phenomena, is a relatively recent approach applied to learning strategies, this research intends to amalgamate the results of a small sample of metacognition research papers regarding learning in adulthood to draw general conclusions from them. Moreover, the focus on adult research makes it salient within the Metacognitive Learning literature. Therefore, the purpose of this study is to identify and contrast specific rudimentary strategies of metacognition found in recent literature that are specifically designed for regulating and supporting adult learning. Considering the focus of this paper, this literature review intends to answer the following research question: Which metacognitive approaches have been suggested as effective strategies for increasing the capacity to learn in adults?

Metacognition

How is metacognition defined and what are the dimensions of this construct? Metacognition is the process in which the individual self-regulates and self-assesses their approach towards effective mental processes, which has been popularly defined and coined by Flavell (1979, p. 906) as "thinking about thinking". Similar to other constructs within the domains of human learning, metacognition has an unbalanced research focus on children and adolescents. metacognition is a recent concept that withholds an extensive theoretical background. Some argue that it

pulls back from the Socratic Method (Aznar-Minguet, 1993) while others find that it has some affinity with the constructivist theories of Lev Vygotsky, William James, and Jean Piaget (López, 2016). Which may push metacognition through a delimited view to study younger humans, which may even affect the general approach of metacognition. For example, Cross and Paris (1988, p. 131) go as far as to define metacognition as: “The knowledge and control children have over their own thinking and learning activities.”

An important aspect of metacognition is to “...include such things as knowing the limits of one’s learning capabilities and using effective strategies to learn new material” (Omrod, 2016). However, to “learn how to learn, we must first learn how to think”, and for this, individuals must develop their metacognitive thought process for overcoming learning obstacles (Aznar-Minguet, 1993, p. 5), which can be used for practical, abstract and even online learning (Pratama, Dimla, Lai & Lughofer, 2019).

As illustrated in Figure 1, the classical model of metacognition proposed by Flavell (1985) consists of two main dimensions: knowledge of cognition and regulation cognition. Knowledge of cognition refers to the recognition of one owns mental capacity through the declarative knowledge of oneself, procedural knowledge of the tasks at hand and strategy knowledge for adapting to our conditioning. Regulation of cognition refers to the self-cognitive capacity of planning, monitoring, controlling and evaluating our internal and external demands (Eytel, 2001).

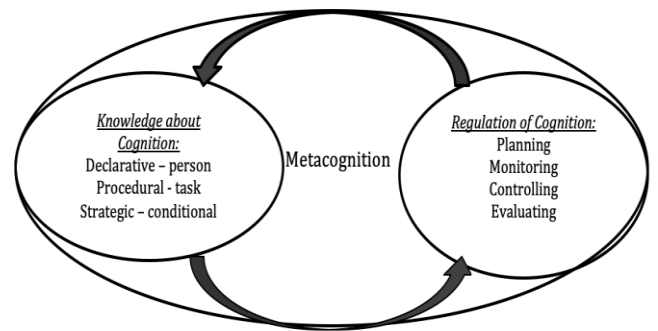


Figure 1: Conceptual framework of metacognition

The importance of this review relies on its partial alleviation for the shortfall in metacognition research regarding adult learning. This is accomplished by connecting and evaluating isolated adult-focused metacognitive learning research. Given to the paucity of adult-focused metacognitive research and the lack of research that combines both children and adults in their metacognitive tasks (Salles, Ais, Semelman, Sigman, & Calero, 2016), this paper may be beneficial for those interested in conducting metacognitive programs or research targeted for adults. By highlighting the distinctions within adulthood, this review may aid in studies concerning adult students, adult learning in the workplace, language learning of illiterate adults and it could aid adults struggling with learning disabilities, among other benefits.

In this study, scholarly peer reviewed publications about metacognition strategies used for adult learning are presented. These studies will fall within one of the different schools of adult learning: Behaviorist (learning behavior through controlled external environments), Humanist self-determined learning), Social-Cognitive Learning (learning through interaction and observation), and Constructivist (learning through the personal signification of events and objects) (Merriam & Caffarella, 1991).

Method

Through the use of EBSCO-host, ProQuest Central and PsycINFO, and initial review of 100 studies were narrowed to 10-scholarly peer reviewed articles regarding the use of metacognition through different aims in adult learning. The key words were: metacognition and adult learning, adult metacognitive learning, metacognition and learning in adulthood, and metacognitive learning in young and old adults. This selection was based on the criteria of inclusion. The criteria of inclusion for this review consisted of: studies from the past five years, the use of the metacognitive theory for adult learning, scholarly peer reviewed articles and studies with samples from the adult population.

The research papers that were excluded did not fit into framework of this paper. Specifically, articles about reflective learning strategies, metacognitive learning of children and adolescents, memory and metacognition, adult learning motivation and other papers that were deviated from the focus of this article were excluded. The research approach, scope, the research design, method, most significant results, limitations and recommendations were not considered for exclusion. After the exclusion process, 10-scholarly peer reviewed articles were selected for framing the research problem and to subsequently identify effective metacognitive strategies, metacognitive learning of children and adolescents, memory and metacognition, adult learning motivation and other papers that were deviated from the focus of this article were excluded.

The research approach, scope, the research design, method, most significant results, limitations and recommendations were not considered for exclusion. After the exclusion process, 10-scholarly peer reviewed articles were selected for framing the research problem and to subsequently identify effective metacognitive strategies

for increasing the capacity to learn in adults. The data from these 10 articles was abstracted and coded. Within this research, an evaluation of the quality of each study was not conducted, mainly because the goal was to narrate general findings of metacognitive learning strategies to derive future directions of research.

Results

In the first reviewed paper about metacognition and adult learning, German researchers Skulmowski and Rey (2017) explored if bodily effort enhances learning and metacognition through an experimental transversal approach. The population that participated in this research consisted of German native speaking university students. The sample size of this research consisted of 48 participants whom took part of one of the two experiments conducted in this research. The design and procedure of this research consisted of having the experimental group conditioned by having them wear a backpack weighing 15% of the weight of each participant while learning 21 new words. The words were of presented in a tablet, in a consistent manner, with varied difficulties and while standing (with the backpack on for the experimental group and without wearing the backpack for the control group). The technique used to analyze the information collected was, firstly, through a scoring process of the correct words written down for a maximum total of 20 points earned, 1 point per correct word written down. For the second experiment, the word list featured nouns of higher difficulty than the words used in the first experiment.

The most important findings of this research were that learning (with a low cognitive load) and metacognition can be strongly enhanced by physical effort induced by carrying weight. Under given circumstances, this study implies that physical effort may support cognitive processes by increasing physiological

arousal. One of the limitations of the research was the generalizability given that some participants may have had more experience with memorizing words and that the demographic only consisted of all adult students. A limitation of the design is that backpack manipulation may affect demand characteristics, while the limited task of only learning words, hampers the inferential that every cognitive task could benefit of a bodily effort. Therefore, the authors recommended using a varied population, adding an emotional component to the design, and incorporating different methods of inducing physical effort.

Similar to the study concluded by Skulmowski & Rey (2017), Teng (2017) also examined the relationship between task-induced involvement and word learning in adults. In a correlational quantitative and experimental study. However, in this research, Teng (2017) related the knowledge and regulation of cognition as a mediator to the effects of task-induced involvement load on word learning and confidence judgements. This model was developed to examine if a high degree of task-induced involvement load would improve word learning as a function of metacognitive knowledge and regulatory skills.

The population consisted of adult university students who have learned English as a Foreign Language (EFL) for at least six years. The sample of this study were 77 undergraduate students majoring in English. The demographics consisted of 18 men and 59 females with an average age of 19 years old (Teng, 2017). The experiment consisted of an experimental group taking a reading treatment and by taking the Vocabulary Knowledge Scale twice, once at the beginning to measure participants' prior knowledge and once after the experiment to measure improvement in word learning (Teng, 2017). The self-report instrument used to measure metacognition

was a modified version of the *Metacognitive Awareness Inventory* (MAI) which is included two subscales (knowledge of cognition and the regulation of cognition).

The most important findings of this research suggest that task-induced involvement load is not significantly mediated by the knowledge of cognition, but it is significantly mediated by the regulation of cognition. This is important because it confirms that the two components of cognition are independent from one another and could mediate differently in the cognitive processes. Also, it was found that “the presence of the two constituent aspects of metacognition, or at least one of them, leads to greater confidence” (Teng, 2017, p. 13). The findings suggest that learners with a higher level of knowledge of cognition and regulation of cognition performed better in word learning, which makes metacognition a predictor of high-quality learning. Another salient finding is that learners may benefit from high difficulty, high involvement load tasks, which is congruent with the findings of Skulmowski & Rey (2017). Similar to the limitations in Skulmowski & Rey (2017) study, the population was limited to the same non-diverse demographic background (in both studies the population consisted of adult students).

In another research about learning in the context of linguistic related tasks, Henter (2014) assessed if metacognitive strategies were effective for increasing metacognitive awareness in learning a foreign language (English). The population consisted of 94 adult university students from Transylvania University of Brasov. The experimental groups undertook a training program of metacognitive strategies for learning a foreign language. The metacognitive strategies for these groups consisted of 1) modeling, 2) reflective journals, 3) reflections on activities, 4) generating

questions, 5) identification of problem solving, 6) thinking-aloud protocols, 7) walking through images, 8) semantic maps, and 9) selective attention (Henter, 2014). The technique used for collecting data consisted of a pre-test and post-test questionnaire of the *Metacognitive Awareness Inventory* (MAI). The research also included an English language test (adopted from the Oxford Placement Test) to assess the previous and post-experiment knowledge of the English language (Henter, 2014). The most important findings of this research show that the knowledge of metacognitive strategies improves foreign language learning, and that metacognitive awareness may be increased through the exposure to metacognitive programs. One of the limitations of the research was that the authors only collected data from a non-diverse population (Henter, 2014).

However, metacognition is not a one size fits all remedy, that works for all types of learning tasks. In another research about metacognition and adult learning, a qualitative exploratory approach was used to correlate the relationship between metacognitive regulation strategies and learning patterns. Specifically, the author was interested in exploring “the nature of metacognitive behaviors and their effect in learning outcomes.” (Porumb, 2017, p. 7).

The population of this research is consistent with the characteristics of the populations that have been used in the other reviewed studies within this paper. Consequently, the authors selected their participants through a purposive sampling of adult university students. The sample included 97 adult university students, consisting of 54 females and 43 male subjects, with an age average of 21 years old (between 19 and 23 years of age) (Porumb, 2016).

The technique used to answer the research questions consisted of a longitudinal design that exposed participants to a virtual learning community (Moodle Learning Management System) for carrying out learning activities in a four-month period. Information was collected through situational metacognitive interviews and reflective diaries (which consisted of activities, goals, motivations, emotions, and cognitive benefits and planning (Porumb, 2016). The most important finding of this research is the emergence of the spectral narrowing and metacognitive movement. These notions suggest that planning strategies may not always be related to learning activities. Porumb (2016) suggests that a lack of structure in task criteria affects the strategy selection for solving an unstructured task, and that metacognitive behaviors such as self-monitoring and evaluation cannot be performed under an unstructured task. The results show that metacognitive strategies and knowledge were only applied when solving structured tasks, whereas metacognitive knowledge weren't used in unstructured learning task (Porumb, 2016), rather the participants would just withdraw from the task. It is salient that even though the participants self-reported their level of metacognitive knowledge they may have been biased by personal belief and over esteemed their level of metacognitive knowledge, which may have affected the results and the occurrence of giving up or withdrawing from unstructured tasks instead of planning, monitoring their results and self-regulating.

The results that Porumb (2016) present may suggest that metacognition is best applied towards learning a task in a known, structured context with explicit criterions. However, in the event of encountering an unstructured or unfamiliar setting, planning, monitoring and self-regulation should be key skills for overcoming ambiguity to achieve learning and task completion. Therefore, in contrast, a

research was conducted by Fuentes (2014) in which the relationship between problem-based learning and metacognition was examined. This study was researched among a population of adult university students. The sample consisted of 34 students (13 males and 21 females) with an age average of 38 years old (Fuentes, 2014).

The design of this research was a longitudinal quasi-experimental study with a pre-test and post-test questionnaire to assess the development of metacognition. The experimental procedure consisted of an Instructional Treatment of problem-based learning with a duration of two weeks, which were monitored through a Virtual Learning Environment (Fuentes, 2014).

The most important finding of this research was that virtual learning in groups fostered autonomous practices and higher levels of metacognition. Given that the adult students had 38 years of age in average, Fuentes (2014) suggested that age may have mediated the effect that virtual learning had on problem-based metacognition learning. Specifically, because the participants demonstrated they had knowledge of metacognitive strategies in their pre-test results. In general, the results of this research show that after the participants received the group virtual instruction treatment, they demonstrated higher levels of metacognitive knowledge in the post-test. One of the limitations of this research was that there was not a control group, which limits the inferences that can be made from the results. Additionally, the small sample size also hampers the generalization of the results.

There are some factors that may affect the use and application of metacognitive knowledge and strategies (Fuentes, 2014; Porumb, 2016), such as: teaching techniques, group interaction and peer support, and the level of structure in learning tasks in group interventions.

However, there are also internal factors that might hinder or enable metacognitive behaviors in adults, and one of these may be the Superego. To examine the relationship between the superego and metacognition, Parviz et al. (2017) embarked upon a cross-sectional study with a correlational design. This study was researched among a population of 206 adult students at Ferdowsi University of Mashhad with an average age of 25 years (ranging from 18 to 58 years) (Parviz et al., 2017). The *Metacognitive Awareness Inventory* and the *Superego Questionnaire* were used. The results of this research suggest there is a negative relationship between superego and metacognition, and a significant positive correlation between consciousness (which is one of the three dimensions of the superego questionnaire) and metacognition (Parviz et al., 2017). In a broader view, these results suggest that adult learning can be influenced by high levels of superego because of its impact on metacognition. In the author's own words: "...metacognition and consciousness can be strengthened by reducing the severity of the superego to improve mental health" (Parviz et al., 2017, p. 6).

Apart from the influence that neurotic disorders and the level of superego has over metacognition (Parviz et al., 2017), another important internal factor to consider when assessing metacognitive strategies is the differing individual learning styles within a group. For this, Arias et al., (2014) examined the relationship between Kolb's Learning Styles Model (divergent, assimilator, convergent and accommodating) and the three dimensions of metacognition (self-knowledge, self-regulation and evaluation). The population was comprised of adult university students from three universities in Arequipa, whom were majoring in psychology. The sample included 273 students (Arias et al., 2014). *The Inventory of Learning styles* from Kolb, as well as the *Inventory of Metacognitive Strategies* were used. The

most important findings of this research were that inverted relationships were found among the variables. Specifically, high levels of reflective learning style related negatively with pragmatic learning styles, and active the learning styles related negatively with theoretical learning styles. However, an interesting finding is that the assimilator style, which is the most reflective style of learning, did not correlate with metacognition as expected. In fact, the learning style that predominated is the divergent style of learning. Additionally, it was found that generally, students' metacognition levels are very low. Arias et al. (2014) explains that these results should be affected by the age and development stage of the participants (whom were mostly first year undergraduate students), since the divergent style of learning tends to decrease in the later years (Arias et al., 2014).

Another individual factor that could be considered when assessing metacognitive knowledge and strategies are metacognitive personality traits. To examine this possibility, Karpov et al., (2017) explored this relationship through 8 psychological assessments which included: 1) diagnosing reflexivity, 2) determining the intensity level and the direction of reflection by using the Reflection Questionnaire, 3) the *Scale of Self-Assessment of Metacognitive Behavior*, 4) the *Metacognitive Awareness Inventory*, 5) the *Everson Questionnaire*, 6) the *Questionnaire for Diagnosing Meta-Decisions*, 7) evaluating signs of a quadrilateral and 8) puzzles. (Karpov et al., 2017). The population of this study was comprised of adult students and employees from multiple private and public organizations. The sample included a total of 100 subjects from ages 20 to 48, no age average nor gender means were offered (Karpov et al., 2017).

The most important findings of this research were that: 1) a correlation was found between learning-ability

development and the development of metacognitive processes and personality traits, 2) as learning ability increases, the level of structural organization of metacognitive traits also increase, 3) as learning ability develops, the development of metacognitive traits increase too, 4) metacognitive personality traits enables the process of mastering new material (Karpov et al., 2017). Another important finding is that students would most often choose to start learning elements of the new material that were had an average level of difficulty instead of an easy or hard difficulty, which supports the notion that the learning activity depends on the level of difficulty of the new material. In Karpov et al., (2017, p. 9) own words; “subjects with the highest degree of learning ability had the highest indicators of metacognitive processes and personality traits”.

Up to this point, the reviewed papers suggest that there are both external factors from the learning contexts, and individual traits that influence metacognition in adults, which produces different learning outcomes. Considering the previous statement, Manasia (2015) conducted a research to explore the differences among learning contexts and subjects. Specifically, this research aimed towards examining through a qualitative design, which metacognitive strategies relate to learning patterns. For this research, learning patterns were based on Vermut's model which consists of four learning patterns were revealed, prototypically named undirected learning, reproduction-oriented, meaning (MD) and application oriented (AO) patterns (Manasia, 2015).

The population consisted of adult students who were undergraduate university students from three Romanian universities. The participants were sampled through a purposive sampling procedure through (social media, posters, flyers, and email campaigns). The initial sample consisted of a total of 87 participants.

However, given that the participation of this study was volunteered, only 37 subjects were fully involved in each phase of the project. From this final sample, 19 subjects were females and 18 were males, and they had an age average of 21 (Manasia, 2015). The technique used to answer the research questions consisted of a Photo-voice (PVM) and experience-sampling methodologies (ESM) interpretive phenomenological analysis. The Photo-voice methodologies were used to support the reflection of the participants, and consisted of subjects photographing life experiences to describe the way they learn and understand learning. Participants would write narratives with about each picture, which supposed the reflection on learning. The ESM measured the participant's feelings, thoughts and actions (Manasia, 2015).

The most important findings of this research were, in the author's own words: "learning patterns may vary across time, contexts, and persons. Students with meaning and application-oriented patterns apply deep learning strategies, but they need external regulation to improve metacognitive skills and learning outcomes." (Manasia, 2015, p. 16). Another important aspect of this research is that it showed features of different learning patterns present in each participant which suggests there may be an overlapping of learning patterns and behaviors.

This understanding should be present when designing appropriate and relevant learning experiences. Therefore, it is important to understand and control the variables that impact the shift between one learning and another. Specifically, these findings suggest that learning patterns could change across contexts, time and subjects. Which implies that teachers, time and subjective learning experiences are key-variables to consider when designing learning programs to change negative

learning patterns into positive ones (Manasia, 2015).

Mohd & Ismail (2017) examined through an experimental design if six common metacognitive learning strategies could be used as computer-assisted learning tools for supporting computer programming learning. The six metacognitive learning strategies that were examined were: 1) metacognitive scaffolding, 2) reflective prompts, 3) self-assessment, 4) self-questioning, 5) self-directed learning and 6) graphic organizers. The population of this study consisted of undergraduate Computer Science adult students. The sample was comprised of 66 participants (39 females and 27 males).

Similar to the other experimental methods discussed in this paper, the technique used to answer Mohd & Ismail (2017) research questions consisted of an experimental design where the sample of participants were randomly divided in two groups (experimental and control group) and given a four-week training course of Introductory Computer Programming. The experimental group were given the metacognitive support system, and the control group were only given ordinary class sessions. A pre-test and a post-test of the Knowledge monitoring assessment (KMA) were administered to assess Computer Programming knowledge before and after the intervention program.

The most important findings of this research demonstrate that metacognitive support systems have a positive effect on learning computer programming. Thus, the computer-assisted learning support may aid learners when learning computer programming. Mohd & Ismail (2017) argue that the 6 metacognitive strategies (metacognitive scaffolding, reflective prompts, self-assessment, self-questioning, self-directed learning and graphic organizer) can especially help learners with knowledge monitoring and problem-

solving. Mohd & Ismail (2017) did not present any limitations, but it was apparent that the sample size (N = 66) and training duration (4 weeks) were limitations. However, the authors recommend that future research should examine “how other factors contribute to learning success in computer programming subject” and they also suggest to “get more respondents to be participated as well as to increase the duration of training session (e.g., one semester) to see the effectiveness of the proposed system” (Mohd & Ismail, 2017, p. 9).

Discussion

When assessing the main similarity and difference among the revised research, an integrative review analysis was conducted where it was observed that some of the results support previous theories while others produced new findings for the metacognitive learning domain. To accomplish this, the data was abstracted in the form of descriptive information systematized in concordance with the purpose and research question. Differences in coding was avoided, and the data abstraction was carefully monitored during the review process to ensure quality and reliability.

Following these guidelines, it was found that various strategies (both external and internal) may increase metacognitive learning in adults. Specifically, eighteen (N = 18) metacognitive learning strategies were identified: 1) using physical effort for tasks with low cognitive load, 2) reflective journals, 3) reflections on activities, 4) generating questions, 5) identification of problem solving, 6) thinking-aloud protocols, 7) walking through images, 8) semantic maps, 9) selective attention, 10) modeling, 11) teaching techniques, 12) group interaction and peer support, 13) high levels of structure in learning tasks within group interventions, 14) high levels of conscience, 15) an alignment of teaching

programs with individual learning behaviors (divergent, assimilator, convergent and usher), 16) the presence of metacognitive personality traits in subjects, 17) an alignment of teaching programs with learning patterns (prototypically oriented, reproduction-oriented, meaning oriented and application oriented) and 18) metacognitive cyber-support systems.

A common limitation from all the research papers that have been presented in this paper, is that the population demographic only consisted young adult university students. Therefore, I would recommend expanding the metacognitive research towards other fields of study such adult learning in the workplace, computer learning in adults, language learning for illiterate adults, among other possibilities. While each research tackled different goals and objectives that are non-comparable, the main difference that was found among the reviewed literature was the method divergence between Teng (2017) and Henter (2014) when examining similar themes (language learning). In the results of these papers it was found that Henter (2014) differed from Teng (2017) in the data analysis, given that Henter (2014) inferred the existence of a learning progress, solely based on the results of experimental groups post-test of the English Language Test, and used these results to assume there was also a progress in the knowledge of metacognition.

In contrast, Teng (2017) administered a self-report questionnaire for assessing knowledge of metacognition, which may not have accurately measured learners' metacognition given to a possible biased self-estimation, but at least the inference was based on a measure (within its limitations). Arias et al. (2014) obtained interesting results which suggest that young adults metacognition levels are low.

Table 1: *Summary of articles*

Authors	Article	Sample	Metacognitive Strategy
Skulmowski & Rey (2017)	Bodily effort enhances learning and metacognition: investigating the relation between physical effort and cognition using dual-process models of embodiment.	(N = 48) Students or past university students.	Physical effort induced by carrying weight.
Teng (2017)	The effects of task-induced involvement load on word. Learning and confidence judgments mediated by knowledge and regulation of cognition.	(N = 77) Undergraduate students majoring in English.	Task-induced involvement load.
Henter (2014)	Developing metacognitive skills as a foundation of learning a foreign language.	(N = 94) Adult university students.	Metacognitive strategies training.
Porumb (2017)	Metacognitive regulation strategies in higher education.	(N = 97) Adult university students.	Structuring learning tasks.
Fuentes (2014)	El aprendizaje basado en la resolución de problemas y su efectividad en el desarrollo de la metacognición.	(N = 34) Adult students.	Group virtual instruction treatment.
Parvis et al. (2017)	Study of the relationship between superego and metacognition of male and female students.	(N = 34) Adult university students.	Reducing the severity of the superego.
Arias et al. (2014)	Estilos de aprendizaje y metacognición en estudiantes de psicología de Arequipa.	(N = 34) Adult university students.	Learning styles should be considered per adult age group.
Karpov et al., (2017)	The interconnection of learning ability and the organization of metacognitive processes and traits of personality.	(N = 100) Adult university	Learning ability development.

		students & workers.	
Manasia (2015)	Cognition and metacognition in self-regulated learning. A positive learning patterns analysis.	(N = 87) Adult university students.	External regulation of meaning and application-oriented patterns.
Mohd & Ismail (2017)	Metocognitive support accelerates computer assisted learning for novice programmers.	(N = 66) Adult university students.	Metacognitive support systems.

Considering that the results could be affected by the early age and development stage of the adult participants, these results support the supposition that the divergent style of learning tends to decrease in the later years of adulthood. Therefore, future research could should correlate the assimilator and divergent learning styles to metacognition in a mature adult sample to explore which style is more appropriate in mature adults. Following Karpov et al., (2017) study of correlating personality traits with metacognition, it would be valuable to perform an experimental sequential design to examine how personality traits could change across the adult's lifespan and how this affects learning outcomes when mediated by metacognitive program interventions. Although the purpose of this paper was to engender new ideas and directions for metacognitive learning research of adults, there are some limitations that should be considered. This paper has a small sample size (N = 10) of studies that performed their research on mostly young adults and generalized their results towards all adults.

Moreover, the metacognitive strategies that affect learning outcomes in adults covered in this paper, although diverse, should not be assumed as a comprehensive list. The studies reviewed in this paper inclined towards a young average age among the adult participants. This could be due to availability, given that most

participants were university students. Future reviews could focus on metacognitive learning studies that emphasize exclusively on older adults, to examine the generalization of the findings reviewed in this paper and to evaluate if these results are in concordance with other similar studies.

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