Understanding the Power of Self-Awareness Through the Evaluation of Metacognition and Cognitive Learning Styles

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The philosopher Confucius famously said, "By three methods we may learn wisdom: First, by reflection, which is noblest; second, by imitation, which is easiest; and third by experience, which is the bitterest" (Gonzalez-Perez & Taras, 2015). The concept of metacognition, originally coined by Flavell (1979), is defined as "cognition about cognition or thinking about one's own thinking" (Hartman, 2001, pg. xi). As Confucius examined, self-reflection (a crucial piece of metacognition), is a vital part of gaining wisdom and learning. Metacognition includes "reasoning about reasoning, reasoning about learning, and learning about reasoning (Kralik et al., 2018). A simple form of metacognition would be when a student considers various studying strategies to learn material for a test. In this case, the student would be thinking about how to go about learning most effectively.

This review aims to define the power metacognition holds, particularly in fostering learning, through the discussion of various models and theories. Metacognition is directly tied to human performance because people with higher metacognitive skills show better performance and more expertise in their domain (Schraw, 1998). Because of the strong tie to human performance, it is crucial for experience designers to understand how to effectively leverage the use of metacognition in every interaction they design, from websites to physical products. This review also aims to explain the relationship between metacognition and cognitive learning styles. All interactive experiences require learning, so it is beneficial to design experiences in a way that facilitates metacognition, manages cognitive load, and aligns with people's preferred learning styles. The remainder of this review will evaluate the Albert mobile app, an app that facilitates saving money and learning about personal finance strategies, and how the app aligns with learning styles and developing metacognitive skills.

Metacognition Overview

Metacognition and executive function are interrelated concepts tied to thinking and learning because they are both "higher-order cognitive processes" that develop as children grow (Kuhn, 2000; Roebers, 2016). Yuki (2019) clarifies that metacognition exists within the Executive Function associated with the medial prefrontal-parietal network; therefore, "metacognition is considered to be the behavioral output of executive function" (Stucke, 2017). Stucke explains how reading comprehension requires both: metacognition is needed to strategize about skills like re-reading, while the executive function is needed to hold the information to be comprehended in working memory. Building a metacognitive strategy allows people to find something that works for them, like relating to prior experiences, which "reduces memory load [to] promote a deeper level of understanding" (Schraw, 1998).

Metacognition matters and is fundamental for survival because it affects the human performance of comprehension, learning, critical and reflective thinking, decision-making, problem-solving, and retention (Sengul, 2012; Hartman, 2001). Schraw (1998) explains the two

main components of metacognition are *knowledge of cognition* and *regulation of cognition*. Cognitive knowledge includes *declarative knowledge* "about" things, *procedural knowledge* of "how" to do things, and *conditional knowledge* of "why" and "when" (Schraw, 1998). Regulation of cognition includes planning and selecting strategies, monitoring performance and self-awareness, and evaluating efficiency and effectiveness of reaching goals (Schraw, 1995, 1998; Jacobs & Paris, 1987). Flavell's idea of metacognition is similar by recognizing metacognitive knowledge and experiences, goals/tasks, and actions/strategies (1979). In summary, metacognition is an iterative process: (step 1) self-assessment of where one stands in their mind, (step 2) setting goals of where one wants to be and what they want to achieve, (step 3) creating and choosing a strategy and plan, and (step 4) self-monitoring of progress and performance to make adjustments and modifications. Understanding metacognition and how to further develop one's metacognitive skills is powerful because humans can then use their metacognitive knowledge to maximize learning per their preferred learning style.

Cognitive Learning Styles Overview

While metacognition allows humans to personally evaluate and develop their ability to learn efficiently, cognitive learning styles (CLS) illuminate how humans are "inclined to approach a learning situation [which have] an impact on performance and achievement of learning outcomes" (Cassidy, 2004, pg. 420). It is important to grasp what is meant by CLS, and in the research, a few terms are often used interchangeably, including learning style, cognitive style, and learning strategy. Cognitive styles were originally explained by Allport (1937) as "an individual's typical or habitual mode of problem-solving, thinking, perceiving and remembering," and learning style, originally described by Riding & Cheema (1991), is concerned with "the application of cognitive style in a learning situation" (Cassidy, 2004, pg. 420).

Witkin and Asch (1948) were also pioneers in the field reporting "experimental evidence of individual differences in information processing strategies," now called CLS (Witkin et al., 1977, as cited in Duff, 2004). It is crucial to understand individual differences because humans will vary in how they filter new information which could "prevent the mental assimilation or accommodation of ideas" explains Jonassen (2012, Introduction). Similar to how the definitions range in the research for each term, there are also many different models and theories to represent cognitive and learning styles.

Theories and Models of Cognitive Learning Styles

Many researchers have studied cognitive styles and learning styles with the idea in mind that if a person's preferences can be classified, then systems can be designed to accommodate their preferences and increase learning effectiveness (Valley, 1997). With so many theories and styles studied ranging from cognitive styles to personality styles, and a great deal of intersecting content, there have been attempts aimed at simplifying the concepts in a more digestible way.

Cassidy (2004) compiled the three main simplified models: Curry's (1987) *onion metaphor model*, Riding and Cheema's (1991) *fundamental dimensions model*, and Rayner and Riding's (1997) *personality, cognitive, and learning-centered models*.

- Curry's model has four layers representing an onion: *instructional preference* [most easily influenced outermost layer], *social interaction, information processing,* and *cognitive personality* [most stable and innermost layer] (Cassidy, 2004).
- Cassidy mentions Riding and Cheema's model sorts all recognized information processing styles into two categories, a *wholist-analytic category* where humans tend to process in separate components or as a whole, and a *verbalizer-imager category* where humans tend to recognize information as either words or images.
- Lastly, Rayner and Riding's model is based on Grigerenko and Sternberg's (1995) style theory. *Cognitive-centered styles* includes Riding's earlier wholist-analytic and verbalizer-imager distinction, *learning-centered styles* focuses on the impact on learning such as process and preference styles, and *personality-centered styles* which are limited in influence, but include the Myers Briggs style model (Cassidy, 2004).

Within each of the three cognitive/learning style overview models, there are many tests associated with measuring the individual's metacognitive tendency and preference in each style including, but not limited to, the Learning Preference Inventory (Rezler & Rezmvic, 1981), Learning Style Inventory (Kolb, 1976), Embedded Figures Test (Witkin, 1962), and Cognitive Style Analysis (Riding 1991) (as cited in Cassidy, 2004).

Summary of Prevalent Cognitive Learning Styles

The three models described above show how humans develop and display "preferred patterns for engaging the physical, mental, and emotional requirements" when engaging in learning (Jonassen, 2012). When humans are learning in their preferred style, they are likely to be metacognitively engaged and using an elevated metacognitive ability to create deeper learning and understanding. The following list of styles with information from Rayner & Riding (1997), Cassidy (2004), Valley (1997), and Jonassen (2012) provides a brief overview of cognitive styles that align with the three main models discussed earlier. Within each style, humans have a metacognitive tendency to lean in one direction or the other to better process information.

- ***Field-dependence - Independence*** (Witkin, 1962): Field dependents have difficulty picking out correct information out of noise. Field independents have an easier time picking out correct information from an array of other information (Jonassen, pg. 87).
- ***Visual – Haptic*** (Rouse, 1965): Visual learners prefer processing information through seeing, while haptic learners learn best by touching/feeling (Jonassen, pg. 177).
- ***Verbalizer - Visualizer*** (Paivio, 1971): Visualizers prefer to learn by seeing while verbalizers prefer words and reading/listening to learn (Jonassen, pg. 191).
- ***Leveling - Sharpening*** (Holzman & Klein, 1954): Levelers tend to miss small details and changes in info and often integrate information easily when trying to memorize information. Sharpeners do not miss details or differences, they usually can memorize originals in more detail (Jonassen, pg. 201).

- ***Holist - Serialist*** (Pask, 1976): Holists focus on a bigger, broader picture and make high-level connections when processing complex info. Serialists focus on operations and the details when processing and learning complex info (Jonassen, pg. 209).
- ***Impulsive - Reflective*** (Kagan, 1965): "Impulsives respond faster and commit more performance errors, whereas reflectives have longer response times and commit fewer performance errors" (Kagan, 1965, 1966, as cited in Jonassen, pg. 113).
- ***Analytical - Relational*** (Ausburn & Ausburn, 1978): Analytical learners focus on details of objects and avoid distraction of wholes, and relational learners do not focus on seeking out differences between objects and prefer accepting whole objects (Jonassen, pg. 221).
- ***Assimilation - Exploration*** (Kaufmann & Martinsen, 1991): Assimilators tend to handle problems through familiar strategies, while explorers tend to be more creative and look for new strategies (Cassidy, pg. 429).
- ***Adaptors - Innovators*** (Kirton, 1978) Adaptors prefer problem solving through conventional procedures, while innovators tend to restructure and focus on finding new perspectives (Rayner & Riding, pg. 9)

Although this list is not exhaustive, it shows there are many different learning styles, meaning all humans and disciplines will vary in how they learn best and will relate to a combination of the styles mentioned. Humans will always prefer learning in the style that is comfortable and works for them, so designers should take this into account and design to facilitate approachable learning in all experiences. This also means designers should take opportunities to make accommodations for those who may need extra help based on their learning styles—creating accommodation improvements will elevate the experience for all users.

Case Study: Albert App

Albert is a financial service mobile app that empowers users to have a healthier financial life through automated savings, a support genius, and a range of personal finance tools such as auto-budgeting and investing. Albert was designed as more than just a focus on fancy financial features. There are hundreds of budgeting apps, but Albert sets itself apart with its education component. Albert has created an interface resembling a basic game that teaches and empowers users to better their financial situation through "missions" ***(Figure 1).***

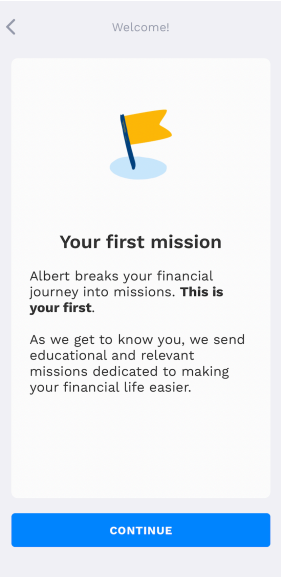

Figure 1 – Albert uses "missions" to continually teach and challenge users to better their financial situation.

Many apps and websites tend to teach users how to use the app in a few onboarding screens, but then teaching and learning falls off—in other words, they hope users just figure it out. Some users will (sharpeners, serialists, impulsives, verbalizers, etc.) while others will need more instruction (field-dependents, visualizers, relationals, etc.) Albert effectively manages cognitive load by not trying to teach users everything about the app and its abilities all at once. It gives enough information to start during onboarding,

but it recognizes money management is a difficult and often anxiety-driven experience for its users ***(Figure 2)***, so it empowers them to take one step at a time. For users who want to move ahead and may be more serialist or field independent and do not need as much support, they can move forward through Albert's "Financial Checkup" screen ***(Figure 3).*** Albert has done well appealing to visual learners by displaying progress charts and graphics on almost every screen ***(Figure 4)***, which is important considering most adults are visual learners (Cherry, 1982, as cited in Jonassen, 2012).

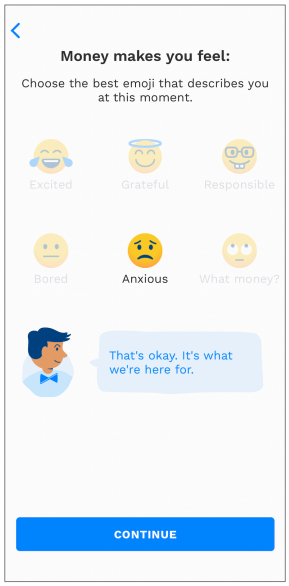

Figure 2 – Albert realizes users may experience a range emotions with money management, so they aim to make the situation less stressful.

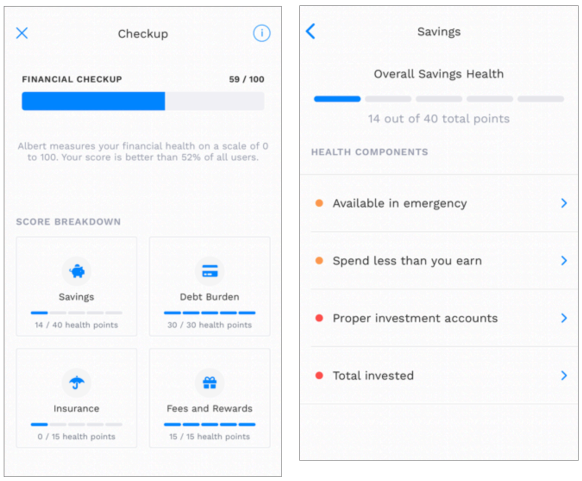

Figure 3 – Albert realizes users may experience a range emotions with money management, so they aim to make the situation less stressful.

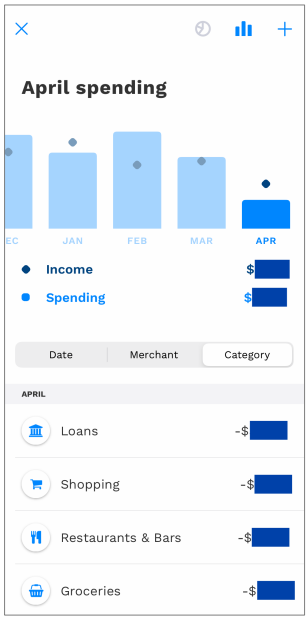

Figure 4 – Just one of Albert's many screen showing strong visuals to help users understand their financial situation. Note the chart options at the top right where users could see a pie chart too.

Support and learning are built into every aspect of Albert. Many apps have help centers, as does Albert, but it also has "Albert Genius." Albert Genius is a powerful part of the app because it allows users to simply send a text and reach a real person to answer their questions quickly ***(Figure 5).*** This appeals to multiple learning styles such as novices and adaptors. Beyond the genius tool, Albert has step-by-step descriptions of how sections of their app works, and these descriptions are always easy to access and swipe through ***(Figure 6).***

Further, Albert uses very clear and simple language which affords easier use of the app as a whole through statements such as "tell me more" and "rainy day fund" and key insights about usage each week, which will draw verbalizers to this aspect. Instead of using complex budgeting that resembles accounting software as competitors do, Albert paints a clear picture of income vs. bills vs. spending and makes it easy to understand how much spending money is available each

month ***(Figure 7).*** If users want to see details and the breakdown, they can, the holists and serialists will appreciate each respective level of detail mentioned.

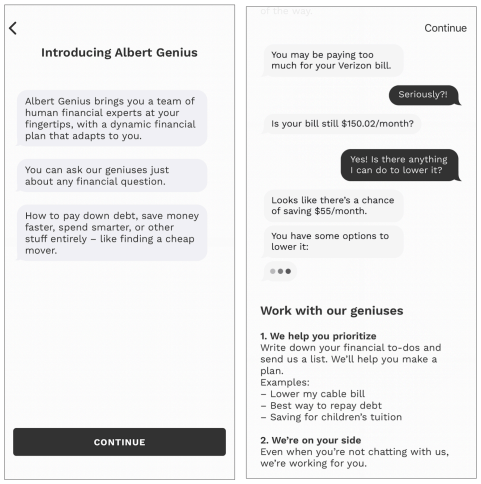

Figure 5 – Albert Genius introduction to users and an example Genius texting conversation.

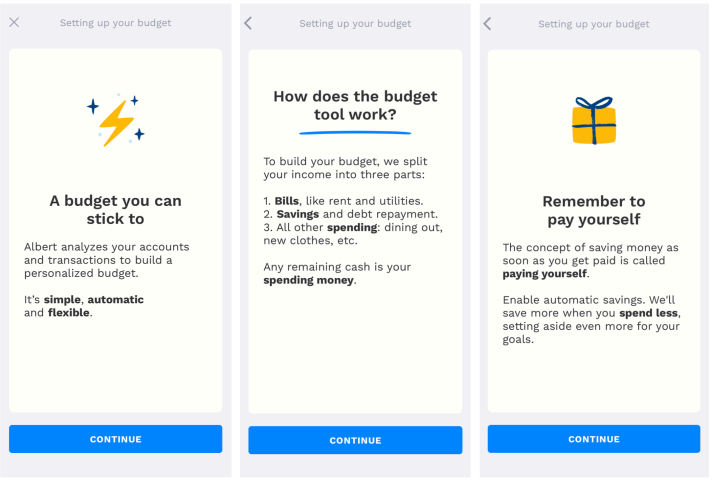

Figure 6 – Screens showing how Albert teaches users about money management tools in an easy to digest, step-by-step format.

Overall, Albert provides opportunities for users to leverage their metacognitive knowledge and apply strategy to improving their financial situation. Users who need help with processes such as budgeting and saving money will seek an app like Albert, and they will already have metacognitive knowledge and ideas of how these tools should work. Albert allows users to see every step associated with all of the tools it offers, which is powerful for users who display higher metacognitive abilities. Those users will have a goal in mind of where they want to be and will be able to strategize about their situation and leverage the app and their preferred learning style to reach their goals. Albert also allows for a great deal of monitoring, which users of all metacognitive abilities will be able to draw key insight from. As described, Albert has powerful learning and support built-in for multiple learning styles to help users at various metacognitive abilities to effectively use the app.

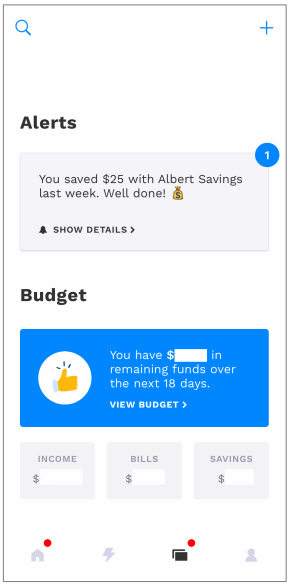

Figure 7 – Albert simplifies the budgeting process allowing users to easily see income vs. bills vs. savings with key insights informing users of spending money.

Conclusion

To conclude, Albert is a well-designed application that leverages a user's metacognitive ability and supports various learning styles through its ongoing education component. When designers consider how to maximize metacognitive abilities and take the time to understand their audiences preferred cognitive learning styles, they can enhance the overall learning and usability

experience for users. As humans grow and learn more about themselves, they gain an understanding about how they prefer to learn and navigate problems and information. In this growing process, they are constantly building and increasing their metacognitive ability by setting goals, learning, strategizing, and planning how to better themselves.

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