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Investigating the relationship between thinking style and personal electronic device use and its implications for academic performance

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ABSTRACT

This article examines the relationship between students' thinking style and the level of their use of personal electronic devices (PEDs). Also investigated are the educational connotations of PED use and the moderating effect of abstract/concrete reasoning on the relationship between PED use and academic performance. To these ends, 506 Taiwanese college students were surveyed. The results point to the significance of concrete reasoning for the prevalence of non-educational PED use, while thinking style is not statistically useful in explaining educational use of PEDs. We also find that thinking style interacts with educational PED use in determining academic performance. As a whole, using PEDs can be academically beneficial or harmful for students depending on whether they use PEDs for educational or non-educational purposes.

Personal electronic devices (PEDs) are an essential part of modern life. Since the introduction of mobile and small-size personal devices in the late 2000s, there has been a clear trend among people toward employing them as their principal communication, information-searching, and entertainment devices. Recent statistics show over 95% of young adults in North America and industrialized Asian countries have a mobile phone, and 30% of these users describe their phone as a device they cannot live without (Pew Research Center, 2014). Similarly, the ratio of individuals using personal portable computers for work and Internet has increased to almost 75% over the last decade.

In this context, researchers have devoted considerable attention to the implication of widespread PED use among students for their academic performance (Barak, Lipson, & Lerman, 2006; Chen & Peng, 2008; Harman & Sato, 2011; Trimmel & Bachmann, 2004). Far less attention, however, has been paid to why some students use PEDs more frequently and extensively than do others. The present study attempts to fill this research void by drawing upon a key thinking-style theory and applying it to the issue of students' use of PEDs and its academic connotation. In our view, potential yet untested factors when explaining the variance of PED use among students are abstract and concrete reasoning. Building on this perspective, we present thinking style here as not only having a direct linkage with the extent to which students use PEDs but also showing its interaction with PED use in determining academic performance. We also examine the direct relationship between PED use and academic performance.

1. Thinking style and PED use

When scholars focus on how people perceive and understand objects and events, they find it useful to distinguish abstract from concrete reasoning, even though they may represent the opposite poles of one cognitive spectrum (Ormrod, 2011). Abstract reasoning pertains to the cognitive capability of analyzing information, uncovering patterns and relationships, grasping multiple meanings, solving problems on a complex level, and formulating theories about the nature of events and ideas. It is contrasted with concrete reasoning, which centers on specific facts, physical objects, and literal definitions. Concrete thinkers consider objects, events, or ideas on the surface level rather than perceiving them as representations of more general concepts or phenomena.

On the other hand, some personality traits such as emotional volatility, extraversion, extra-curiosity, and being highly sociable are reportedly conducive to problematic PED use *including* Internet addiction and compulsive online behavior (Çelik, Atak, & Başal, 2012; Van der Aa et al., 2009; Yu, Kim, & Hay, 2013). Those having such psychological predilections tend to spend excessive numbers of hours on PEDs and computers.

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Interestingly enough, these psychological traits are also characteristic of people scoring high on concrete reasoning (Kolb, 1984). They tend to learn information from specific concrete experiences and develop social relationships with others while exhibiting high levels of openness to and curiosity about new things and experiences. In general, concrete thinkers are also sensitive and feeling-oriented in thought and behavior, spending large amounts of time searching for, reflecting on, and doing things related to how they feel or want to feel.

In contrast, students scoring high on abstract reasoning are known to be rather cautious, reflective, and selective in their process of information searching and pleasure seeking (Kitchener & King, 1981; King & Kitchener, 2004). These traits serve to keep them mindful of the credibility of information and to diversify, if possible, the method of data collection in lieu of heavily counting on one particular device or source. This view is in line with Yamazaki, Murphy, and Puerta (2002) who conducted a two-year longitudinal study on the link between students' thinking style and learning skill. They found that abstract thinkers are significantly stronger in critical thinking and more selective and deliberative in information searching.

Put together, abstract thinkers are generally less emotional, passionate, and people-orientated but more analytical and critical than concrete thinkers. They would be so as well in their PED use, putting them at lower risk of becoming Internet-addicted and compulsive PED users. Such being the case, we may hypothesize that high abstract (low concrete) reasoning is inversely related to the total amount of time that students spend on PEDs in a typical day (Hypothesis 1), which can also be read as expecting that high concrete (low abstract) reasoning positively associates with the extent to which students use PEDs.

2. PED use and academic performance

As already noted, with the dramatic increase in the number and variety of PEDs and their usage among students (Flanigan, 2013), researchers have drawn attention to what effects PEDs exert on students and their academic performance. Both advantages and disadvantages are found in the extant literature.

Potential advantages of using PEDs include increased information searching capability through cyberspace and collaborative learning possibilities with other students since the learning environment has shifted from being teacher-oriented to being student-oriented (Sprenger, 2010). In addition, educational software and use of PEDs for electronic note-taking lead to the increase of learning-related satisfaction, attention, problem solving skills, and promotion of hands-on exploratory learning (Barak et al., 2006; Trimmel & Bachmann, 2004; Siegle & Foster, 2001).

To be fair, scholars have also suggested a negative relationship between PED use and academic achievement, especially referring to PED usage associated with non-educational activities. For instance, when students use laptops in the classroom, if they constantly spend time on the web browsing or multitasking, they tend to have lower grades for the course than those who do not use them in this way (Barak et al., 2006; Ellis, Daniels, & Jauregui, 2010). Other studies showed that students who use cell phones for communication frequently perform poorly in academics (End, Worthman, & Weterau, 2010; Harman & Sato, 2011; Sanchez-Martinez & Otero, 2009). Also, researchers found an inverse linkage between student's grades and time spent on video games (Anand, 2007; Burgess, Stermer, & Burgess, 2012).

With the pros and cons of students' use of PEDs, it seems reasonable to expect that two opposite forms of academic effect exist in regards to the use of PEDs depending on the purpose of their use (Hypothesis 2). We first expect that the effect of non-educational PED use, such as personal entertainment and communication, would be harmful as related with academic performance. A variety of temptations and distractions exist in the online environment. The high use of PEDs can draw young students into the extreme, interactive, and engrossing virtual Internet world cutting the time devoted to school work. Excessive Internet use distracts students and leads to procrastination in relation to academic tasks (Kubey, Lavin, & Barrows, 2001). In a different vein, studies found that when adopted as tools for educational purposes, PEDs can enhance students' learning attention, motivation, satisfaction, and problem solving skills (Trimmel & Bachmann, 2004). Similarly, hands-on activities with laptops promote students' academic achievement insofar as they utilize them for learning and educational activities (Barak et al., 2006). Educational use of PEDs is therefore hypothesized to generate high levels of academic performance.

3. Moderating effects

Another issue to be addressed in this paper is whether or not thinking style interacts with PED use in determining academic performance. Useful for this discussion is our understanding of the connection between fluency and thinking style. Fluency is commonly defined as ease and speed of information processing (Binder, 1996). Even though the literature points to the benefits of fluency for general learning, ease of information processing without accuracy mostly ends up with casual, positive evaluation of problems and issues, engendering cursory acceptance of invalid information as well as deterring analytical reasoning and effective problem-solving (Binder, 1996; Dahaene, 1997; Therrien, 2004). More germane to us, simple fluency is known to decrease as abstract reasoning increases while it increase as concrete reasoning increases (Tsai & Thomas, 2011). This is so because concrete reasoning prompts individuals to focus on specific details rather than bigger pictures. Reversely, abstract reasoning helps people attend to the larger picture and read between the lines by putting and analyzing information in a larger context. For concrete thinkers, even worse is the bearing feelings have on their judgment, a condition which further weakens problem solving and analytical reasoning. The activation of abstract reasoning curtails the influence of feelings as it helps individuals reflect on contents, events, and ideas instead of focusing on a particular object or specific information without context.

This discussion leads to the hypothesis that abstract reasoning moderates (concrete reasoning amplifies) the link between PED use and academic performance (Hypothesis 3). Abstract thinkers are analytical in thinking and information searching. Compared to concrete thinkers, they possibly better grasp the fact that the wide variety of materials on Internet also range in accuracy, reliability, and value. They are likely to be vigilant regarding the limits and problems of online materials and computer-based tasks as a whole. Accordingly, those with high abstract reasoning may supplement their PEDs with traditional information sources such as books, journals, and organizational documents. They would also rather carefully analyze and evaluate the credibility of data acquired via online sources and PEDs and then determine of such information suits their personal needs and standards.

Pertinent to our hypothesis are the results of former research on online learning showing that in online or computer-based class settings students scoring high on abstract reasoning tended to spend more time reading, analyzing, and understanding posted class materials than did concrete thinkers. In a computer-based design course, for instance, Lu, Jia, Gong, and Clark (2007) noticed differences in learning behavior between abstract and concrete thinkers. In their 85-min experiments, on average, students identified as abstract thinkers spent roughly 21 min reading and