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Review

Does multitasking with mobile phones affect learning? A review

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ABSTRACT

Mobile phone multitasking is widely considered to be a major source of distraction in academic performance. This paper attempts to review the emerging literature by focusing on three questions concerning the influence of mobile phone multitasking on academic performance: (a) How does mobile phone multitasking impair learning? (b) Why does mobile phone use impair learning? (c) How to prevent from mobile phone distraction? We use multiple strategies to locate the existing research literature and identified 132 studies published during 1999–2014. The mobile phone multitasking and distractibility are reviewed in three major aspects: distraction sources (ring of mobile phone, texting, and social application), distraction targets (reading and attending), and distraction subjects (personality, gender, and culture). We also compare the results of these studies with the findings on mobile phone multitasking and driving, the earliest area of mobile phone multitasking research. Both limitations of existing research and future research directions are discussed.

1. Introduction

Multitasking can be simply defined as doing more than one thing at a time (Wood et al., 2012). Junco and his collaborators (Junco, 2012; Junco & Cotton, 2012) further defined multitasking as "divided attention and non-sequential task switching for ill-defined tasks as they are performed in learning situations" (Junco, 2012, pp.2237). This definition is closely related to the classical selective attention research of Michael Posner, one of the eminent psychologists of attention. Posner (1990) distinguished two types of attentional task that can help to understand multitasking. The first type is divided attention, which means individuals process more than one stimulus at the same time, resulting in imperfect selections of information (Posner, 1990). The second is rapid attention switching in which individuals only process one stimulus at a time but rapidly shift back and forth between the stimulus (Posner, 1990). In this situation, it both takes more time to process the information (Wood et al., 2012) and results in missing some information during the process of switching between the stimuli.

Building on these thoughtful definitions, in the present article, we defined mobile phone multitasking while learning specifically as both divided attention and rapid task switching between learning and off-task mobile phone use. Based on this definition, if individuals are reading a research article and checking mobile phones frequently for coming emails simultaneously or sequentially, then they are mobile phone multitasking while learning. However, if individuals are using mobile phones to read a research article for learning, then they are doing mobile learning or m-learning rather than mobile phone multitasking with off-task activities while learning.

Three major reasons motivated us to review the current literature: the prevalence of mobile phone multitasking while learning, the complexity of this issue, and the urgency of understanding this issue. First, advances in mobile phone, especially smartphone, and the wide coverage of 3G or even 4G fast speed service made mobile phone no longer just a tool for making phone call or texting. These advances dramatically promoted the number and types of activities in which we can engage in with mobile phone: finding information from website, locating address, connecting to social networks, reading online news, or taking and sharing pictures. Simply put, by using mobile phone, we can access to information at any place and in any time. Firat (2013) defined and compared two groups, digital immigrants and digital natives. Digital immigrants (Firat, 2013) refer to people born before the blooming of digital technology who got used to use paper-based communication and are struggling with catching up with the technology era. Digital immigrants are

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the "net generation" born after 1980 who can access information from anywhere at any time from any sources. Comparing to the digital immigrants group, they have some salient characteristics, including higher access speed, searching for instant pleasure, impatience in linear thinking, and most importantly, higher multitasking ability and continuous partial attention. It is so common for digital natives nowadays to use mobile phone to attend multiple streams of information while reading, doing homework, or listening to the lecture. Some of multiple streams of information are academic related. In the ECAR (Educause Center for Applied Research) study of undergraduate students and information technology (Dahlstrom, 2012), Eden reported the percentage of students using smartphone for academic purpose was about twice as many in 2012 (67%) than in 2011 (37%), through a variety of mobile-friendly institutional service and resources, including grade checking, course websites/syllabus, and course management system (Dahlstrom, 2012). However, often times, when students have access to mobile phone while learning, they are more likely to engage in off-task multitasking behaviors. Tindell and Bohlander (2012) reported 90% of university students in their study said they text messaging during classroom presentation. Murphy and Manzanares (2008) found that when instant messaging used as instructional tool, students engaged in off-task multitasking which negatively impacted learning (Murphy & Manzanares, 2008).

Second, mobile phone multitasking and learning is not a straightforward issue to investigate. For instance, it has been found that different multitasking tasks may produce different interference (Brooks, 1968; Wood et al., 2012). When we engage in two similar tasks, such as taking lecture notes (verbal) and texting (verbal), our performances are more likely to be impaired. However, our performance may not be significantly influenced when the two tasks involved are unrelated, such as taking lecture notes (verbal) and viewing a picture your friend texts you (visual). The first example is called general interference while the second one is specific interference. Therefore, in terms of mobile phone multitasking while learning, it is necessary to discuss the interference taking into account the specific type of tasks involved in, which add the complexity of the problem.

Third, in contrary to the prevalence and complexity of mobile phone multitasking while learning, few studies have explicitly investigated the relationship between mobile phone multitasking and learning outcome. While most of the current studies were self-reported and correlational, researchers started to conduct experimental studies to find out the effect of mobile phone multitasking in real world classrooms. Two review articles have been published to date. In Levine, Waite, and Bowman (2012) review article, they reviewed articles on the effects of mobile media multitasking on academic performance as well as driving, walking, and working. They concluded that media use is positively correlated with trait impulsivity and distractibility but the direction of effects is not clear. A more recent review was conducted by Carrillo and Subrahmanyam (2014). They grouped the current literature on mobile phone multitasking and learning based on the two settings of the studies, in the laboratory or in the real-world classroom, and described the differences between the findings. Studies conducted in the laboratory settings found that multitasking with mobile phone while learning had negative effects on learners' efficiency but not comprehension, while the studies conducted in classroom showed negative effects on learning and recall (Carrillo & Subrahmanyam, 2014).

The present review extended the two existing reviews in three aspects. Firstly, we not only reviewed the empirical evidence on the effect of mobile phone multitasking on learning but also reviewed variety of theories that can be used to explain the effect. Secondly, we referenced findings from the earliest and most productive area in the science of mobile phone multitasking behavior: phoning while driving (Yan, Chen, & Yu, 2013). Thirdly, we took into account the differences among specific type of tasks (i.e. ring of phone, texting, Facebook, etc.) involved in the mobile phone multitasking while learning. This article attempts to review the existing literature to answer the following three questions: How does mobile phone use impair learning? Why does mobile phone use impair learning? How to prevent from the negative effects of mobile phone multitasking while learning?

2. Method

Multiple search strategies were used to locate the existing research, including computer search of electronic databases, manual search of references of identified articles, and consultation with experienced librarian. Multiple major databases, including PsycINFO, Scopus, ERIC, and Education Research Complete, were searched. Three groups of key words were used in the initial literature search. The first group is related to mobile phone, such as mobile phone use, mobile phone use, texting, and mobile phone conversation. The second group is related to multitasking, such as distract, multitask, and media multitask. The third group is related to learning, such as learning, classroom, lecture, and academic performance.

One hundred and four studies explicitly examined mobile phone multitasking while learning have been selected under review, including self-report studies, correlational studies, and experimental studies in both laboratory and real-world classroom settings. Two criteria were used for literature selection. Firstly, the studies included in the review must examine multitasking activity that can be achieved by using mobile phone. Secondly, we included studies that investigated the cell phone use in at least one of the following ways: cell phone conversation, text messaging, social networking (e.g. Facebook or Twitter), physical operations of cell phone (e.g., picking up the phone or dialing the phone), or operations associated with finding online information through cell phone (e.g., locating an address or reading news).

3. How does mobile phone multitasking impair learning?

In general, mobile phone multitasking results in distraction through three major ways, distraction sources (e.g, Campbell, 2006; Shelton, Elliott, Eaves, Lynn, & Exner, 2009; Harman & Sato, 2011; Junco, 2012), distraction targets (e.g., Bowman, Levine, Waite, & Gendron, 2010; Fox, Rosen, & Crawford, 2009), and distraction subjects (e.g., Foehr, 2006; Zhao, Reimer, Mehler, D'Ambrosio, & Coughlin, 2013).

3.1. Distraction sources

3.1.1. Ring of mobile phone

In Campbell (2006) study, he surveyed 176 participants including both faculty and students at an American university. Most faculty and students reported ringing of mobile phone is a serious source of distraction and irritation in classroom. Campbell (2006) believed this finding can be explained at two levels: on the surface level, it is because of the normative expectations of classroom; on the deeper level, mobile phone intrusion in the classroom is a serious problem because mobile phone distraction is believed to have negative impact on learning outcome. Röer's team (Röer, Bell, & Buchner, 2014) asked 26 university students to name a list of annoying sound. Ringing of mobile phone was the second most-mentioned sound listed by 73% of the participants (the first most-mentioned sound was dentist drill). Röer's team explained the annoying nature of mobile phone ringing from the acoustics