The Smartphone as a Self-regulatory Planning Tool: Promise or Peril

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Abstract—This study examines the relationship between student planning, smartphone use, and course achievement. The ubiquitous smartphone can promote or hinder learning depending upon how it is used. Prior research has explored overall smartphone use (e.g., hours used) and generally found negative relationships with academic achievement. This study investigates the learner's approach to a specific academic endeavor, planning, and how the choice of support tools may relate to self-regulated learning skills and course grade. First-year college students reported on their approach to academic planning and how popular tools such as the smartphone and/or a planner were used to that end. The results indicated a strong relationship between both modes of planning and self-regulated learning skills (planner, $R = .305$, $p < .01$; smartphone, $R = .157$, $p < .01$). The modes of planning had a differing effect on course grades when controlling for self-regulated learning skills with the smartphone planning demonstrating a negative influence ($ß = –.078$, $p < .05$) and the planner or notebook demonstrating a positive influence ($ß = .082$, $p < .05$). The findings suggest that teachers and students should critically examine the tools they use to support academic goals.

Keywords—smartphones, self-regulated learning, academic planning, m-learning, ubiquitous technology

1 Introduction

The smartphone is an ever-present, multi-use device that has the potential to support or hinder the instructional enterprise. The capacity for the device to attract and maintain the attention of the user is substantial. This could be valuable to the learner if the functionality is appropriately directed. The opportunity to use the smartphone for learning support tasks such as setting reminders, recording goals, and monitoring study time is countered by seemingly endless notifications and temptations. Research into the relationship between student engagement, technology, and higher education is critical to supporting learner success [1].

The purpose of this study is to improve our understanding of how the smartphone impacts the learning experience. In particular, this study examines the relationship between student planning, smartphone use, and course achievement. Student planning tasks such as maintaining a calendar, to-do list, and goals are typically completed with

a smartphone or a notebook/planner. This study investigates how the different tools related to self-regulated learning skills and how the tools impact achievement.

Below the smartphone conundrum is introduced. This is followed with a review of relevant literature supporting each side of the conundrum. The described study investigates one practical example of this conundrum, whether to use the phone or a notebook for typical academic planning activities (calendar, to-do list, and goals) and is that use influenced by self-regulatory skills. Following the results, a discussion of the findings and implications are presented.

2　　The smartphone conundrum

The implications of a ubiquitous, handheld supercomputer for the learner have been broadly studied since the introduction of the iPhone in 2007. This line of research has taken on greater intensity as the adoption of the smartphone has surpassed that of any technological device in history [2]. A recent study of smartphone use amongst Flemish adults [3] indicated that the smartphone was picked up an average of 50.6 ($SD = 32.1$) times a day and used for over three hours ($M = 190.4$ minutes, $SD = 123.7$). The research into educational implications can be roughly divided into hindrance and support. Instructors are cognizant of the potential benefits and barriers inherent in the presence of the smartphone [4]. On the one hand, extensive use of a smartphone has been associated with depression [5], lower achievement [6], [7], and learning environment disruption [8], [9]. Alternatively, proponents will point to the potential for greater social connectivity [10], academic support [11], and increased learner engagement [12].

2.1　　Hindrance

A good proportion of the attention paid to the use of the smartphone and learning environments has focused on negative consequences. These negative effects range from mild and annoying unwelcomed notifications to more consequential impacts on mental well-being. The challenges inherent in the extended use of the smartphone are such that screen time has become a measure to which researchers, parents, educators, and policymakers are paying close attention [13], [14].

Depression. At the most troubling end of the spectrum of concerns regarding the use of the smartphone are those regarding mental well-being. There is some evidence that problematic smartphone use (i.e., excessive) is associated with neuroticism [15], [16], rumination [17], and future depression [5]. While beyond the scope of this study, it is important to acknowledge that encouraging the use of a device for altruistic purposes can have unintended consequences. Educational environments where the use of the smartphone is restricted might be the only respite for some.

Achievement. A variety of studies have looked at the implications of smartphone use on achievement. Research investigating overall smartphone use (i.e., "How much time do you spend on your phone?") and academic achievement has revealed a negative association [7]. An extensive meta-analysis of ten years of smartphone research found that overall mobile phone use had an overall negative impact (R = −.162) across a broad range of studies [18]. Other studies have explored more specific uses of the

learning-related smartphone activity (i.e., use of the smartphone while studying), and while not refuting the association, they failed to demonstrate statistically significant direct influences on achievement [19]. Why the smartphone might have this deleterious effect is of considerable interest. In a meta-analysis of mobile phones' impact on learning, researchers identified multitasking and distractibility as key components of the relationship model [20].

Multitasking and distraction. Any digital device has the potential to distract the learner. Early observational studies of one-one computing environments where all students were given a laptop demonstrated the significant amount of off-task behavior that can result [21]. Researchers investigating the use of laptops have identified negative consequences for note-taking during lectures [22]. A more recent study on the use of the laptop for note-taking did not reveal a significant difference in outcomes (i.e., the proportion of complete idea units) when compared with longhand. However, when digital distractions were incorporated, the laptop users' notes were more likely to be adversely impacted [23]. The reality of the negative consequences of these uses is often countered with purported benefits of multitasking [24].

This is not to say that learners do not recognize the consequences of multitasking and other distractions. However, there is evidence that learners fail to make appropriate adjustments to the learning environment to accommodate these inefficiencies [25]. This points to the need to consider the metacognitive skills of the learner when considering the impact of the smartphone on learning. In particular, monitoring for understanding becomes a key activity for the learner when the smartphone is present [25]–[27].

2.2   Support

In spite of the potential pitfalls of the smartphone, there are few people who are willing to forgo its use for any extended period of time. In fact, the device is quickly becoming a required accessory for functioning in contemporary society. Activities such as personal banking are using the smartphone to verify the user's identity. Academic conferences no longer print programs and rely completely on mobile apps to guide participants. A majority of college students report using the smartphone to access course materials and are increasingly forgoing the use of the laptop for learning purposes [28]. Previous research has demonstrated a strong positive association between smartphone use intentions and perceived academic performance [29], [30]. The convenience, capability, and ubiquity of the smartphone all point to the criticality of the device to the learning enterprise. However, it is reasonable to question the affordances of the device as suggested by technology conglomerates that stand to gain from increased use. The challenge for educators and researchers is to parse the feature sets of the technology to serve the needs of the learner.

Social connectedness. For many, the smartphone is a connection to the broader world. For example, the positive role of support groups for those facing mental and physical health challenges has been widely recognized in the research community [10]. The utility of popular apps, such as Facebook and Twitter, is ascribed in part to the feelings of connectedness they engender [31]. Of particular interest here is the role that this social support might play in student success. Online learning research

has consistently identified the merits of teacher and student connectedness [32]. Connectedness in online learning presents a different set of challenges than one finds in the face-to-face classroom. However, the already graying line between online, hybrid, and face-to-face learning may become largely absent in the post-pandemic academic community. The smartphone has and will play a key role in establishing and maintaining this connectedness.

Academic support. A comprehensive meta-analysis of the use of mobile learning devices (e.g., smartphones, PDAs, and tablets) in support of learning indicated the use of these devices in reading, science, and mathematics lessons can lead to improved academic outcomes [33]. A limited number of smartphone studies were included in the meta-analysis. Of particular interest here, and notably absent from the research literature, is the use of the smartphone for academic self-regulation. For all of the possible "off-task" uses the device offers, it can be a powerful personal assistant. The simple default functionality of an iPhone or Android phone provides innumerable supports (e.g., calendar, task list, calculator, and timer) that could be marshaled in support of academic success. In addition, a seemingly infinite number of creative apps are being developed. A plethora of existing apps can support activities such as goal setting, focused studying, and paper writing. Recent research has begun to identify approaches that might be more conducive to learning. One study of the development and implementation of an evidence-based language learning smartphone app reported superior results when compared to traditional instruction [34].

3   Purpose

This study examines the role of the smartphone as it relates to academic planning and course achievement. Self-regulated learning (SRL) is defined as a dynamic process "whereby learners proactively monitor, control, and regulate their thoughts, feelings, and behaviors to achieve self-set learning goals" p. 302 [35]. The positive relationship between self-regulated learning (SRL) and academic achievement is clear. In particular, the benefits of planning, time management, and goal setting are broadly evident [19], [36]. Harnessing the smartphone in support of these activities would suggest improved academic outcomes. However, with the advantages of the smartphone come opportunities for distraction. Using a physical planner or notebook could potentially support the described self-regulated activities while forgoing the potential for distraction. Investigating whether the advantages are sufficient to overcome any negative consequences of the use of the smartphone is the focus of this study.

The relationship between hours habitually committed to studying and achievement has been well documented [37], [38]. The student who is better able to commit time to academic pursuits is at an advantage compared to those who have extensive work and family commitments [39], [40] or those who, as noted 55 years ago by Sexton, "… spend more time on nonacademic reading and on fraternity and sorority activities." [38] p. 306.

The progression from secondary school to the less structured university setting necessitates an increased commitment to time management and planning. Productive

time management planning and attitudes strongly influence student grade point averages [41]. For most, this means the use of a calendar or some type of physical planner. The use of a planner amongst college students is conspicuously absent from the research literature. Anecdotal observations indicate that physical planners had been a standard issue for university students of prior generations. More recent anecdotal observations indicate that the percentage of students each year who are using a physical planner is inversely related to the percentage of students using a smartphone.

Corollaries can be found in literacy research comparing print and digital texts. When undergraduate students were asked to read digital and print texts, they unsurprisingly expressed a preference for digital [42]. In spite of this preference, study participants demonstrated better recall for key points when reading print versions. One meta-analysis of similar studies indicated that this finding is robust and increasing [43]. Another meta-analysis found similar overall results (Hedges $g = -.25$) but noted substantial differences between narrative ($g = -.04$) and expository texts ($g = -.32$) [44]. In addition, students were better able to monitor their understanding in the print conditions. This finding supports the importance of considering self-regulated learning skills when investigating the impact of digital solutions. The importance of monitoring accuracy can be seen across disciplines [44]–[46]. Monitoring accuracy may be particularly important in learning scenarios that involve digital options. A preference for digital solutions might bias student estimates of learning.

3.1 Present research

Prior research has investigated the possible negative and positive roles of the smartphone in academic achievement. Existing research has provided limited guidance regarding the type of use that might support or hinder learning. One possible use of the smartphone that is of import to students is to support academic planning. Using the smartphone to manage a school calendar, to-do lists, and academic goals could promote improved academic outcomes. Of course, similar tasks can be completed with a physical planner and/or notebook. The notebook would provide fewer opportunities for distraction. Also, the depth of processing benefits noted in related research [47] might also prove valuable.

This study investigates the relationship between self-regulatory learning (SRL) skills, the use of the smartphone for academic planning purposes, the use of a planner or notebook for academic planning purposes, and academic achievement. In particular, this study will address the following questions:

1. Do SRL skills positively influence:
    a. the use of the smartphone for academic planning?
        i. Hypotheses 1a–SRL skills will positively influence the use of the smartphone for academic planning
    b. the use of a planner and/or notebook for academic planning?
        i. H1b–SRL skills will positively influence the use of a planner or notebook for academic planning

2. Does the choice of tool for academic planning influence academic achievement?
   a. Does the use of the *smartphone* for academic planning positively influence academic achievement while controlling for SRL skills?
      i. H2a – Use of the smartphone for academic planning will positively influence academic achievement while controlling for SRL skills.
   b. Does the use of a *planner and/or notebook* for academic planning positively influence academic achievement while controlling for SRL skills?
      i. H2b – The use of a planner and/or notebook for academic planning will positively influence academic achievement while controlling for SRL skills.

4   Methodology

To answer the above research questions, participants completed a series of cognitive and behavioral measures. The measures were distributed in the 12th week of a 16-week Fall semester. A link and description of the study were provided in the course learning management system. The study procedures were reviewed and approved by the university's Institutional Review Board.

4.1   Participants

Study participants were enrolled in a first-year seminar course for students who have not yet been admitted into a major. First-year students are particularly vulnerable to studying challenges as a new level of independence is experienced. This particular course is suitable in that it attracts students from a wide range of interests and disciplines.

Completion of the measures was required for the course. However, only data from those who a) agreed to participate in the study, b) were 18 years or older, and c) had completed fewer than 19 credits by the end of the semester were analyzed. The resulting dataset included 784 (407 female, 377 male) complete responses. The mean age was 18.45 years with a standard deviation of 1.65.

4.2   Measures

Self-regulated learning (SRL). Eight items from the resource management component of the Motivated Strategies for Learning Questionnaire (MSLQ-RM) were used to measure SRL skills. These items center on skills most relevant to academic planning. Items address time management (e.g., "I find it hard to stick to a study schedule" reversed) and effort regulation (e.g., "Even when course materials are dull and uninteresting, I manage to keep working until I finish" reversed).

Academic planning. A set of six items were developed to measure participants' academic planning. Participants were asked to rate how typical these activities were for them on a 5-point Likert scale (1 not at all –> 5 very typical).

1. I use *my phone* to manage my school to-do list. (To Do Phone)
2. I use my phone to manage my school calendar. (Calendar Phone)

3. I use my phone to remind me of my (daily/weekly/term) academic goals. (Goals Phone)
4. I use *a planner or notebook* to manage my school to-do list. (To Do Notebook)
5. I use a planner or notebook to manage my school calendar. (Calendar Notebook)
6. I use a planner or notebook to remind me of (daily/weekly/term) academic goals. (Goals Notebook)

The first three items were converted into an Academic Planning – Smartphone composite. The remaining items were summed for the Academic Planning – Notebook composite.

Course grades. Academic achievement was measured using the first-year seminar course grades. The grade for this course was chosen because the other measures were associated with this particular course. In other words, the responses to the questions regarding planner use would be implicitly tied to the course which was asking the question. Letter grades for the first-year seminar were converted to a course grade point average (range 0.0, F to 4.0, A).

5 Results

To clarify the independence of the two planning factors (smartphone and notebook), the six items were entered into an exploratory factor analysis using principal axis factoring extraction and varimax rotation. The overall Kaiser-Meyer-Olkin measure of sampling adequacy was .678, above the recommended .6 [48]. Using an eigenvalue cutoff of one, two factors were identified, with all six items clearly loading on the appropriate factor (Table 1).

Table 1. Planning with smartphone and notebook/planner

	Factor 1	**Factor 2**	**Uniqueness**
To-Do Notebook	0.872		0.697
Calendar Notebook	0.932		0.727
Goals Notebook	0.754		0.575
To-Do Phone		0.863	0.534
Calendar Phone		0.784	0.498
Goals Phone		0.645	0.428
Eigenvalue	2.57	2.06	
% of Variance	42.9	34.3	
Cumulative %		77.2	

Notes: The principal axis factoring extraction method was used in combination with a varimax rotation. Loadings below .15 are hidden.

Participants reported using the smartphone ($M = 9.0$, $SD = 3.6$) and a notebook ($M = 8.9$, $SD = 4.1$) for planning at a very similar frequency. The zero-order correlations (Table 2) support the contention that students who report more frequent use of self-regulated learning behaviors also engage in more planning-related behaviors using

their smartphones and notebooks. The association is stronger between SRL and the use of a notebook (R = .305, p < .01 one-tailed) than the smartphone (R = .157, p < .01). A high correlation between SRL and first semester GPA is also evident (R = .374, p < .01). The associations between the planning items and course grades are mixed.

Table 2. Means, standard deviations, correlations, and Cronbach's Alpha (parentheses in matrix diagonal) for all variables

Variable (items)	Mean	SD	SRL: Resource Management	Academic Planning Smartphone	Academic Planning Notebook
SRL: Resource management (8)	29.9	4.8	(.79)		
Academic Planning — Smartphone (3)	9.0	3.6	.157**	(.80)	
Academic Planning — Notebook (3)	8.9	4.1	.305**	.078*	(.89)
Course Grade	2.8	1.4	.374**	−.013	.190**

Notes: * p < .05. ** p < .01. (1-tailed).

To clarify the relative contributions of the different modes of planning (smartphone vs. notebook) while controlling for SRL, a sequential regression analysis was conducted (Table 3). Course grade was regressed first on SRL: Resource management. The two planning mode variables were added in the second block. The addition of the two variables produced a statistically significant change in variance explained (ΔR^2 = .012, p < .01). Planning with a smartphone was a significant negative predictor of the course grade (β = − .078, p < .05). Planning with a notebook was a significant positive predictor of the course grade (β = .082, p < .05).

Table 3. Sequential regression of course grade on resource management, planning – smartphone, and planning – notebook

Variable	Model 1			95% CI B		Model 2			95% CI B	
	B	ß	SE B	LL	UL	B	ß	SE B	LL	UL
Constant	1.110		.200	.717	1.503	1.205		.206	.801	1.609
Resource management	.075***	.375	.007	.062	.088	.072***	.362	.007	.059	.086
Planning Smartphone						−.021*	−.078	.009	−.039	−.003
Planning Notebook						.019*	.082	.008	.003	.036
R^2		.140					.152			
ΔR^2							.012**			

Notes: CI = confidence interval; LL = lower limit: UL = upper limit. * p < .05. ** p < .01. *** p <. 001.

6 Discussion

The purpose of this study was twofold. First, we sought to understand the association of SRL skills with the use of the smartphone for academic planning purposes and the use of a planner or notebook for academic planning purposes. Second, we investigated the influence of SRL and tools for academic planning on academic achievement. We will review the associated research questions and main findings in the next two sections.

6.1 SRL and academic planning tool

The first research question posed was, "Do SRL skills positively influence the use of the smartphone for academic planning and the use of a planner and/or notebook for academic planning?"

The results indicate that the SRL skill, resource management, exhibited a strong positive correlation with the use of the smartphone for academic planning (R = 0.157 p < .01). A similar and stronger, positive relationship was exhibited with the use of a planner or notebook for academic planning (R = 0.305 p < .01). Each finding was consistent with the study hypotheses and prior research. The SRL, in general, and resource management, in particular, are skills that may be best exemplified by efforts to better manage time, set goals, and engage in regular academic planning [36].

6.2 Achievement

The second research question posed was, "Does the use of the smartphone for academic planning positively influence academic achievement, and does the use of a planner and/or notebook for academic planning positively influence academic achievement?"

The results indicated that while controlling for self-regulated learning skills, the use of the smartphone for academic planning demonstrated a negative association with academic achievement (ß = –.078, p < .05). In contrast, the results indicated the use of the smartphone for academic planning demonstrated a positive association with academic achievement (ß = .082, p < .05).

With respect to the positive relationship between academic achievement and SRL, this finding has been well established (ß = .362, p < .01). However, given the changing nature of the learning environment, the magnitude and the consistency of the relationship is noteworthy. What was of primary interest in this study was the relative value of the different academic planning tools to achievement. While controlling for SRL, the use of the smartphone for academic planning demonstrated a negative, albeit small, influence on academic achievement. Conversely, the use of a planner or notebook for academic planning demonstrated a small but positive influence on academic achievement while controlling for SRL.

6.3 General discussion

The relative value of using a notebook or planner rather than the smartphone contributes to the larger question of the overall impact of smartphone use on academic

achievement. In one important part of the learning enterprise, academic planning, the smartphone appears to hinder rather than support achievement. Prior research provides some suggestions as to the mechanisms behind this finding. The distractions introduced by the smartphone are often unwieldy. In a study comparing modes of note-taking (laptop vs. longhand-notebook), the introduction (or lack of introduction) of a digital distraction appeared to be the key variable influencing the learning outcome, not the note-taking mode [23]. Choosing the use of the smartphone for academic planning will inevitably introduce more distractions than the alternative. The rabbit-hole scenario, where one sets out on one task and is redirected to a different activity, is now so common that it is likely applauded as a design success by phone manufacturers.

While not a focus of this study, the near equivalence of the choice of planning tools reported by participants was surprising (smartphone $M = 9.0$, $SD = 3.6$ vs. notebook $M = 8.9$, $SD = 4.1$). The ubiquity of the smartphone and its popularity among this population did not foreshadow such an outcome. This may allude to something fundamental regarding how the smartphone is viewed by students. In other words, while they all have a smartphone and use it very frequently, for many, it is simply not an academic planning tool. The development and validation of the smartphone/notebook academic planning measure is another useful outcome of this study. This measure can be used in combination with other related smartphone and learning measures (e.g., [49]) to increase student awareness of the implications of smartphone use on learning.

Future research could expand the methodological tools to incorporate participant rationales for the choice of tools. This would provide a richer understanding of the choices being made beyond SRL definitions. Also, intervention studies where students are encouraged or discouraged to use different tools could provide additional support for academic planning recommendations.

This research contributes to a growing body of literature that moves beyond the general implications of smartphone use for learning by studying specific uses of the device. A recent example describes the relationship between smartphone placement habits and academic performance, with more beneficial study habits (e.g., put it in my backpack) proving superior [50]. This research is important in that it provides evidence and theory-based support for practical suggestions. First-year seminar classes that often strongly emphasize the development of effective time management strategies may then want to encourage students to try out a physical notebook for the semester or to monitor their distractions when using the smartphone for academic planning.

7   Conclusions

This work produced two significant findings. The first is that SRL skills influence the choice of tools used for academic planning. In particular, the more self-regulated student will tend towards using a physical calendar and notebook for typical academic planning activities. The second finding is that choosing the smartphone for academic planning is related lower academic achievement when compared to those who chose more traditional methods.

One implication of this research and the body of literature it supports is the need to raise awareness regarding the apparent trade-off between smartphone use and academic

performance [51]. These findings provide an important opportunity for discussion with learners regarding the core learning concepts such as attention, memory, and multitasking [24]. Instructors can initiate a broad range of evidence-based strategies to support the development of a productive role for the smartphone in the learning enterprise [52]. Broader awareness campaigns are necessary, especially in light of the sizable headwinds presented by the smartphone and social media conglomerates. While the irony is substantial and uncomfortable, a social media campaign may be in order.

8   References

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