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Does Developing a Study Guide Impact Test Performance? A Comparison Between Unguided and Guided Development of Scientific Writing

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Abstract

The present study asked whether voluntarily developing a study guide for the final exam would be positively related to performance on the exam. It also asked whether the mode of study guide development (instructor-guided or unguided) would differentiate the performance of students who completed this task. In the study, the development of a study guide was one of the many curriculum-related activities that students could carry out in a course taught through instructor-guided inquiry-based learning. Because it was not a compulsory activity, 81% of the students completed it. Among these students, no differences were observed in the final grades of the instructor-guided and unguided conditions. However, across all participants, completing the study guide was linked to higher class participation and class grades. These findings suggest that participation in co-curricular activities is a reflection of engagement and desirable performance outcomes.

Keywords: *Inquiry-based learning; study-guide development; co-curricular activities*

1. Introduction

In academic courses, inquiry-based learning is an instructional strategy in which students adopt the practices of professional scientists to acquire the knowledge and skills expected of them. Typical of inquiry-based learning is the fact that students often carry out self-directed learning activities under the guidance of the instructor. Not surprisingly, there has been considerable debate about the degree to which learners should be provided more or less scaffolding (i.e., supportive guidance from the instructor) to perform class-related activities (Tawfik et al., 2020). Scaffolding is conceptualized as "any form of assistance offered before and/or during the inquiry

learning process that aims to simplify, provide a view on, elicit, supplant, or prescribe the scientific reasoning skills involved" (Lazonder & Harmsen, 2016, p. 687). On one side, some studies have reported the benefits of instructor-led teaching, which can be advantageous to novices faced with the tasks of acquiring new and often complex knowledge and skills (Alfieri et al. 2011; Lazonder & Harmsen, 2016). On the other side, other studies have reported the benefits of broadening student-directed learning. It has been argued that the latter gives learners the necessary sense of agency to understand what they know and do not know, develop learning goals, and assess the resources needed to complete the task at hand (Tawfik et al., 2020). Benefits include performance gains arising from the sense of agency that learners experience. Interestingly, inconsistencies in the findings of the extant literature generally involve activities that are part of the curriculum of a course and are thus compulsory. Consequently, one may ask whether academic performance can be impacted by voluntary co-curricular activities with differing levels of instructor involvement. Co-curricular activities are pursuits that entail learning opportunities (i.e., events or tasks) that are related to the curriculum and whose purpose is to enhance its quality and improve learning (Camerato et al., 2019).

Besides the degree of instructor guidance, student engagement is another key issue in the literature on inquiry-based learning. Engagement, which is the effort students direct to course activities, is under their control (Waked et al., 2024). Across disciplines, educators agree that students' engagement is key to successful learning (e.g., Freeman et al., 2014). In co-curricular activities, engagement, conceptualized as a disposition, can impact the decision as to whether to undertake or not such activities (Kuperminc et al., 2013; Olewnik et al., 2023). According to self-determination theory (Ryan & Deci, 2017), the types of motivation propelling the undertaking of co-curricular activities may be a combination of 'identified regulation', and 'introjected regulation'. 'Identified regulation' refers to involvement in a given endeavor because of its relevance to achieving personal goals. 'Introjected regulation' justifies involvement in that endeavor to avoid negative emotions (e.g., "I would be worried if I did not do it"). Because co-curricular activities merely complement the curriculum and generally do not give course credit, they are less likely to be motivated by 'external regulation', which links involvement in a given endeavor to rewards and punishments (e.g., "I would get a bad grade if I did not do it"). Whether the undertaking of particular co-curricular activities can be more broadly related to course engagement and attainment is an open question.

In the present field study, a course devoted to scientific writing taught through guided inquiry-based learning pedagogy was selected. In this context, a co-curricular activity that students could interpret as potentially beneficial to their performance (i.e., the development of a study guide for the final exam), was targeted for experimental manipulation. There were two conditions, instructor-guided and unguided, under which the activity could be performed. The following research questions were asked, each linked to a hypothesis to be tested:

Q1 Do students who complete a voluntary co-curricular activity towards the end of the semester, such as developing a study guide for the final exam, yield higher performance not only in the exam but also in the course? If carrying out this activity is an indicator of a student's effort in the course (i.e., engagement), undertaking this activity would be linked to not only higher final exam grades but also higher course grades (H1).

Q2 Among the students who complete this voluntary co-curricular activity, do instructor-guided and unguided study-guide development yield different perceptions of readiness for the final exam? Do they also yield different performance outcomes? Here, guidance is defined as explicit information regarding the items that the study guide needs to contain. It is a form of scaffolding that tells learners what to do (i.e., develop definitions and examples for each concept covered in this course), providing designated means to carry out the task (i.e., a list of concepts). Based on self-determination theory (Ryan & Deci, 2017), the unguided condition could be described as offering a greater sense of agency. If the satisfaction of students' needs for autonomy and competence are linked to engagement and desirable learning outcomes, the unguided condition should yield evidence of higher final exam performance (H2).

2. Method

2.1. Participants

The participants were 235 undergraduate students enrolled in a compulsory course on scientific writing taught in English through guided inquiry-based learning pedagogy (Lazonder & Harmsen, 2016). They were first-year students (age range: 18-30) who could be classified as Arabic-English bilingual speakers. Proficiency in their second language (English) had been assessed before enrollment as being comparable to that of modest or competent English users (as per IELTS criteria).

2.2. Materials and Procedure

Toward the end of the semester, students in each of the 8 sections of the course were asked about their habits for preparing for the final exam. Most students cited reviewing their class notes as their main strategy. None mentioned a study guide. Following this informal inquiry, a co-curricular activity was proposed, which required students to develop personalized study guides to prepare for the final exam. As an instance of summative assessment, the final exam consisted of simplified abstracts of empirical studies, which students had to analyze based on the methodological concepts acquired and practiced during the semester.

The 8 sections of the course were randomly assigned to either an instructor-guided condition or an unguided condition, all involving the development of student-customized study guides for the final exam. In the instructor-guided condition, the instructor gave students a list of key terms

(i.e., concepts to be tested in the final exam). Their task was to generate a definition of each term and an example. In the unguided condition, the students themselves had to identify the key terms to be tested in the final exam. For each key term, a definition and an example were to be produced. Thus, the two conditions differed in one important way. In the unguided condition, students had to determine which relevant concepts would be included in the comprehensive exam at the end of the semester. In the instructor-guided condition, this information was provided by the instructor. The variable instructor was not confounded with conditions. Namely, random assignment was carried out by ensuring that both conditions were assigned to each of the two instructors selected for the study.

During two class meetings, students were allowed to work either individually or as a group. Most students chose to work individually. They were given approximately a week to complete this task. Irrespective of whether students completed the co-curricular activity with others or alone, each student was to submit the completed work individually through Blackboard.

The development of a personalized study guide was one of the many co-curriculum-related activities that students could carry out during the semester to better understand the class materials. Thus, it was not graded but simply marked as done or not done. At the end of the semester, attendance rates were used to compute an engagement score for each student. The number of classes offered was divided by those attended to compute the engagement score, which was then translated into a percentage (scale range: 0-100) for statistical analyses.

Students who agreed to develop a study guide were asked to estimate their final exam preparation after they submitted the study guide. For convenience, they estimated their readiness on a scale from 0 (not at all prepared) to 10 (completely prepared). Their estimates were then translated into percentages to ensure comparison with the grades students obtained in the course.

At the end of the semester, final exam grades, course (i.e., overall) grades (scale range: 0-100), and engagement scores were collected and linked to the condition to which they belonged. Then, all identifying information was deleted. The study was approved by the Deanship of Research of the hosting institution as complying with the guidelines for educational research of the Office for Human Research Protections of the U.S. Department of Health and Human Services.

3. Results

3.1 Did Completing a Study Guide Impact Grades?

Non-parametric, Mann–Whitney *U* tests were conducted on each performance variable to determine whether there were significant differences between students who did not complete the study guide and those who did. The descriptive statistics of the participants are displayed in Table 1. In the table, the asterisk refers to a significant difference between the two groups of students. Final exam grades did not differ between groups [$U = 4965.50$, *ns*], albeit a trend in

the direction of higher grades for those who completed the study guide emerged. However, the students who completed the study guide exhibited higher engagement [$U = 6895.00$, $p < .001$, with mean rank for completed = 131.91 and mean rank for not completed = 57.61]. They also obtained higher course grades [$U = 6665.50$, $p < .001$, with mean rank for completed = 62.01 and mean rank for not completed = 130.90]. H1 was partially supported.

Table 1. Descriptive statistics (mean and standard error of the mean) of key variables for students who completed (n = 191) or did not complete (n = 44) the study guide

Variable	Did Not Complete		Completed	
	Mean	***SEM***	***Mean***	***SEM***
Readiness for Final Exam			62.10	1.35
Final exam Grade	51.75	3.32	59.02	1.47
Engagement Score *	59.00	3.97	85.73	1.10
Course Grade *	63.59	2.72	79.21	0.69

Note: * = Significant differences

3.2 Did Completing a Personalized Study Guide Impact Grades?

Non-parametric, Mann–Whitney *U* tests were conducted on estimates of readiness, final exam grades, and course grades to determine whether there were significant differences between students in the instructor-guided and unguided conditions. The descriptive statistics of the participants are displayed in Table 2. Estimates of readiness, final exam grades, and course grades did not differ between groups [$U \leq 5034.00$, *ns*]. Students in the unguided-study guide condition, however, obtained higher engagement scores [$U = 5599.00$, $p = .006$, with mean rank for guided = 85.06 and mean rank for unguided = 106.82]. H2 was not supported. The results of the comparisons between conditions, however, supported one of the main tenets of self-determination theory (Ryan & Deci, 2017). Namely, the greater satisfaction of students' needs for autonomy and competence, which was offered by the unguided condition, was linked to greater course engagement. How could an activity carried out towards the end of the semester yield greater course engagement? The study guide assignment was given approximately three weeks before the end of the semester. When the number of class meetings that students attended in these three weeks was separated from those of the previous weeks, students in the unguided condition had better attendance than those in the instructor-guided condition. During the previous weeks, no attendance differences were detected.

Table 2. Descriptive statistics (mean and standard error of the mean) of key variables for students who completed (n = 191) the study guide

Variable	Instructor-Guided Cond.		Unguided Cond.	
	Mean	SEM	Mean	SEM
Readiness for Final Exam	61.09	1.64	63.10	2.15
Final exam Grade	59.22	2.22	58.82	1.94
Engagement Score *	81.91	1.77	89.51	1.21
Course Grade	79.50	0.89	78.92	1.04

Note: * = Significant differences

4. Discussion

The results of the present study can be summarized into two points: First, in a course taught through inquiry-based learning instruction, students who completed the study guide exhibited higher course engagement and obtained higher class grades. A reasonable account for these differences is that students' effort devoted to class activities, as measured by course engagement, was the underlying variable. Ultimately, it led to higher performance in the course. The null finding concerning final exam grades might be traced to the fact that the development of a study guide simply served as a reiteration of concepts already understood by students. Reiteration could be carried out through other means (e.g., review of class notes). Thus, developing a study guide could do little to improve performance above and beyond the impact of other means of reiteration. Nevertheless, a non-significant trend in the direction of higher final grades for those who completed the study guide emerged.

Second, among the students who completed the study guide, there were no significant differences in performance between unguided and instructor-guided conditions. There was a significant difference between conditions for course engagement, favoring higher engagement in the unguided inquiry-learning instruction. Attendance records, which were used as coarse indices of course engagement, indicated better attendance in the last three weeks of students assigned to the unguided condition. Thus, the latter could be assumed to have propelled increased class attendance.

In the comments made by students who estimated their readiness for the final exam, the experience of developing a customized study guide was frequently judged as giving students concrete insight into their readiness. Interestingly, in the instructor-guided condition, most comments were about the study guide as a tool to better remember concepts. Instead, in the unguided condition, most comments were about the increased confidence that students experienced in their readiness for the final exam. Readiness, however, was not about memory. It was about students' critical thinking skills in dealing with the likely contents of the final exam.

Of course, the motivating effect of the sense of agency arising from developing independently of the instructor a customized study guide needs to be further examined. Another limitation of the present study is the self-selection that arose from the study-guide activity being presented to students as one of the many co-curricular options. If the development of a study guide were treated as a compulsory and graded activity, self-selection would have been prevented in the sections randomly assigned to unguided and instructor-guided conditions. Larger samples would have also been available for testing.

In the extant literature, the tasks (assignments and tests) that are used to differentiate conditions are usually not optional co-curricular activities. Generally, all activities subjected to instructional manipulation and upon which performance was measured are compulsory. For instance, in a research-oriented course taught through inquiry-learning instruction, Waked et al. (2024) reported that greater instructor involvement (akin to the instructor-guided condition of the present study) yielded better problem-solving and knowledge-acquisition outcomes. Instead, in a business course, Tawfik et al. (2020) found that less instructor involvement yielded higher conceptual knowledge and causal reasoning when measured through a compulsory assignment. Furthermore, in a psychology undergraduate course, Pilotti et al. (2024) found that a student-directed learning approach (akin to the unguided condition) yielded greater assignment performance than a partially student-directed learning approach (akin to the instructor-guided condition). No prior differences in self-efficacy (i.e., confidence in one's abilities) between the two groups were recorded. In studies involving compulsory activities, what seems to matter is the perceived difficulty of the tasks that students are asked to perform. Greater scaffolding may be needed if the task is novel and perceived as being above the current resources that students possess. Developing a study guide towards the end of the semester is unlikely to be judged as a task that can overwhelm the resources students possess. Thus, the compulsory versus optional nature of the activities subjected to different degrees of instructor involvement may not matter much if the task is perceived as doable. Further research needs to be conducted on co-curricular activities that are perceived by students as challenging.

Lastly, in the literature covering learning, a key distinction is made between learning-oriented and grade-oriented students (Eison, et al., 1986; Pilotti et al., 2022; Pollio & Beck, 2000). In the context of an academic course, the former can be defined as learners whose activities are driven by the desire to acquire desirable knowledge and skills. The latter can be described as learners who view course activities as necessary burdens that can impact their course grades as well as their grade point average (GPA). Both attitudes may also coexist in individual students (Pollio & Beck, 2000). Thus, the degree to which students emphasize learning over grades, grades over learning, or neither may be used as a measure of individual differences within a particular course or across courses. In the present study, the activity of completing a study guide was not graded and thus was not a component of students' course grades. Whether a grade or learning orientation differentially motivated students to complete the activity was examined in debriefing

sessions serving as focus groups. Both attitudes appeared to coexist in the students. No group differences were detected between students who completed or did not complete the study guide. Similarly, no group differences were uncovered between students who completed the study guide under unguided or guided conditions. Further assessment of the learning and grade orientation constructs may uncover differences that the debriefing sessions might have been unable to probe.

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