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Research Participation Improves Student's Exam Performance

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Although there have been several attempts to explore for beneficial effects of research participation in social sciences, most of them have mainly explored satisfaction and students learning perceptions (e.g., Bowman & Waite, 2003). Very few works have studied learning by measuring exam performance. Moreover, participation has been usually conceptualized as a mixture of active and passive participation, including in the same measure different practices such as filling up questionnaires, running experiments or reading and answering questions about a journal article or a scientific conference. The present work tries to determine if there is an advantage due to research participation comparing exam performance, satisfaction and perceived learning of the matter Research Methods in Psychology, in three different groups (non-participating, passive and active participating). As we can see in the results, the mere participation benefits exam performance. Results are discussed in terms of the use of research participation as a new powerful active method in education.
Keywords: research participation, exam performance, satisfaction, perceived learning, active and passive participation.

Aunque ha habido varios intentos por estudiar los posibles efectos beneficiosos de la participación en investigaciones en ciencias sociales, la mayoría de ellos han estudiado la satisfacción y la percepción de aprendizaje de los alumnos (e.g., Bowman & Waite, 2003), y muy pocos trabajos han tomado medidas del rendimiento en los exámenes. Además, la participación ha sido habitualmente conceptualizada como una mezcla entre participación activa y pasiva, incluyendo en la misma medida prácticas muy distintas tales como rellenar cuestionarios, pasar experimentos o leer y responder a una serie de cuestiones sobre un artículo o una conferencia científica. El presente trabajo pretende determinar si existe beneficio en el rendimiento en un examen, la satisfacción y el aprendizaje percibido por los alumnos en la materia de Métodos de investigación en psicología, en tres grupos distintos (grupo de no participación, participación pasiva y participación activa) gracias a la participación en una investigación en psicología. Como se puede ver en los resultados, la mera participación beneficia la ejecución en el examen. Los resultados son discutidos en términos del uso de la participación de nuestros estudiantes en investigaciones, como un nuevo y potente método activo de educación.
Palabras clave: participación en investigaciones, rendimiento en exámenes, satisfacción, aprendizaje percibido, participación activa y pasiva.

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One of the most relevant issues discussed in teaching of any social science is the implication of participation of students in researches (King, 1970). In those sciences that require the collaboration of people to investigate certain human issues (psychology, sociology, economy, teaching…), there is a wide acceptance of using student pools in order to easily get a human sample for doing research. There have been a few attempts to study if research participation of students is a good way to improve their learning during the degree. Most of them have been centered on satisfaction and perceptions of the students about the valuable learning experience of participating in research. Despite a few exceptions (e.g., Coulter, 1986; Miller, 1981), researchers have found that students perceive participation as a good learning experience (Bowman & Waite, 2003; Briton, 1979; Darling, Goedert, Ceynar, Shore, & Anderson, 2007; Landrum & Chastain, 1995; Rosell et al., 2005; Trafimow, Madson, & Gwizdowski, 2006). However, it seems to remain unclear if research participation of students gives them any improvement of their learning or training in the skills they need to successfully finish the degree.

Being student pool so important in order to get participants for research at the university, there has been a research field that has focused its interest in the study of those factors that contribute to an educational and satisfying experience in research participation. Rosenthal and Rosnow (1975) found that research volunteers perceive the participation important and interesting. Bowman and Waite (2003) found that variables like grade expected, gender, employment status, mayor, class size, and number of participation events were closely related to satisfaction not only with participation in research but also with perceptions of better understanding research procedures in the field of study (psychology in that case). On the other hand, there have also been attempts to study how research participation may affect the perception of a certain field of study in the first years of the degree. Rosell et al. (2005) found that student perceptions and topics about psychology in the first year courses may vary depending on research participation. Those first year students who participated in research reported an increment understanding psychological research procedures as well as an increment understanding contemporary psychology. Although the methods used have usually been based in self-reports, some researchers have investigated if the students get any type of learning benefit after their participation in a certain research (Darling et al., 2007; Rosell et al., 2005). One of the most common results found is that students usually report that they learn not only about psychological content but also about the process of conducting psychological research (Darling et al., 2007).

However, one constraint of present studies is that they include not only participation in research projects or "mass testing" sessions involved in a certain research project, but also the attendance of symposiums, reading of research articles or writing summaries of published research papers in the same measure. However, it seems to us that there are qualitative differences between research project participation (regardless of the type of design used by the researches or the instruments to collect the data) with those scholar practices related to a more "self-work" of the student (reading and writing research papers). Research participation seems to be a more passive participation where the students just run an experiment or fill out a questionnaire in which they usually are not involved and in which they don't have any other information than that of running the research. On the other hand, reading and writing about a research paper related to the course of study in which they have to think about of the research paper and have to elaborate and think about of the terms of the matter in order to give a correct response, seems to be designed to produce a greater student involvement in the matter. Including both types of practices in the same measure would distort results and conclusions about the real profit of students' research participation. In fact, there has recently been an attempt to study different types of learning situations (from "only research participation" to other types of learning scenes such as attending class lecture, reading the textbook or summarizing a journal article), finding that students preferred research participation than other types of learning situations (Elliot, Rice, Trafimow, Madson, & Hipshur, 2010).

Another constraint found in most of the studies reviewed is that they usually inform about subjective reports of students, as we have pointed before. Very few researchers have reported about exam performance or any other "neutral measure" not related to a subjective experience of the student. An example of using exams and "more objective" measures to examine possible educational benefits of research participation are Padilla-Walker's studies (Padilla-Walker, 2006; Padilla-Walker, Zamboanga, Thompson, & Schemersal, 2005). She studied if extra credit for research participation may meet educational goals by measuring exam performance (regardless of other subjective measures used in the study). She found that extra credit for research participation might not meet educational goals (Padilla-Walker et al., 2005); however, when she used extra credit performance to predict exam performance, she found that it was a strong predictor of exam performance, above other type of variables such us college grade point average (Padilla-Walker, 2006). Nevertheless, these studies implement research participation and extra credit also by talks, conferences, textbook readings, book chapters…, where students must comment by writing a report about the activity. That is, the type of active participation we pointed before, which seems to be quite different to a simple passive participation in a research project. In fact, Elliot et al. (2010) do a similar distinction and try to measure only research participation separately from other types or learning situations. However, although they try to measure learning outcome, it was done for a very limited concept and single

topic (chunking in memory) which minimizes the generalization of learning in a given psychological matter.

Our main objective in the present study is to determine if there is an advantage in exam performance due to research participation by distinguishing active versus passive participation. We are interested in the impact on the final exam performance as well as in the subjective report of students about their satisfaction and learning perception. As most of the studies reviewed before have shown, students usually report valuable learning of research procedures and methods. Therefore, we conducted our research in a methodology first course in psychology. One way to address if they actually learn about the process of conducting psychological research would be to evaluate their learning within the matter of Research Methods. Another variable to examine in our research will be the difference between active and passive participation in the study, as we have pointed out before. We characterized participation in research by the collaboration as part of the sample pool in a given research project using experimental methods. Students went from a very passive participation (only run the experiment) to an active participation (writing a brief summary of the activity regarding the methods of the study and learning experimental methods within the experience of the experiment run). We measured exam performance and subjective reports of students (satisfaction and perceived learning).

Method

Participants

Participants were 66 undergraduate volunteered students enrolled in a first year Psychology course (55 women and 11 men; mean age 19.17; *SD* = 2.73; *range* 17-33). All of them were enrolled in the course for the first time and have passed an exam to access university studies (in Spain PAU or the equivalent for students above 25 years old). Only 16 of them studied and also worked, being distributed homogeneously for each experimental group (five for the "non participating" (NP), five for the "passive participating" (PP), and six for the "active participating" (AP) group).

Stimuli and Materials

We employed four types of materials. Those related to demographic and self-reported questionnaires measuring opinions about psychology and research methods in psychology, beliefs about research and research participation and opinions about paper-writing participation. Another two types of materials were (a) test exams and (b) a preliminary test asking about their grades in the access to university studies (PAU). Finally, we registered class attendance of all students through the semester and also asked them after the exam to estimate the hours of study dedicated to the matter.

Procedure

We used a between-subjects experimental design with "grade of participation" as the independent variable, with three levels: "non-participating" -NP group- (students who decided not to participate in the experiment), "passive-participating" -PP group- (students who only participated in the experiment but did not have to write a final report about it) and "active-participating" -AP group- (students who participated and wrote a final report).

At the beginning of the semester the students were asked to participate in a pool for experiments lasting one hour and outside of the class, that were conducted in the department by our research laboratory. If they were interested, they had to enroll choosing one day of the scheduled experiments. They were told that no incentives would be given other than the experience of being a part of an experiment pool. Those students who decided to not participate were assigned to the NP group. We would like to emphasize that ethically we cannot obligate anyone to participate in any research, so the NP group is not possible to be randomly formed. However, those students that decided to participate were randomly assigned to the PP and AP groups. In order to obtain two groups as similar as possible, participants were matched in previous academic results (PAU) and then randomly assigned to AP and PP groups. Finally (post hoc) we checked that PAU scores were similar for the three groups.

Then, we asked all the students to participate in the present study regardless of their participation in the experiments pool outside class. For those who decided to not participate in the experiment pool (the NP group) we just asked to fill out the questionnaires inside class and only two of them refuse to collaborate. We told them that the purpose of the present study was to evaluate the new grades in Spain and their methods. After obtaining students consent, participants completed the demographic questionnaires administered by a research assistant in several days of class (when the instructor of the course was not present).

Participants who decided to participate in the experiments conducted several cognitive (selective attention) experiments (between 30 and 50 minutes of duration each one) for approximately one month during the semester (each participant run one experiment). We employed procedures to ensure anonymity and confidentiality. Finally, the AP group was also asked to write a final report about their experience as participant pool, along with some teaching classes driven by the experiments. Specifically, in four hours of class (where the students (AP and PP-NP) were separated for teaching purposes) we explained the chapter "Experimental Designs", following, as examples, those experiments in which AP and PP groups had participated. During those teaching hours, they also had to respond to several questions about the methods used in the experiments, such as identifying dependent and independent variables,

controlled variables and the way used to controlled them, thinking about the reliability and the validity of the experiments, etc. They should include those questions and responses in the final report. On the other hand, PP and NP groups of students attended regular lecturing classes, without any reference, as examples, to the experiments of their participation.

At the end of the course, exam performance was registered through a multiple-choice test for all groups. The exam was the first partial exam of the subject as part of their regular examination in the matter.

Measures

Demographic information. The first nine items collected demographic information such as age, gender, years in school, class size, the number of years receiving the course…

Self-reported questionnaires. Beliefs about psychology and research methods in psychology were measured by a seven Likert form items. AP and PP students completed 14 Likert form questions that assessed research participation satisfaction and perceived learning about their participation. AP students also completed 13 questions that assessed paper writing participation satisfaction and perceived learning with the experience. The questionnaires were based on those used by Bowman & Waite (2003), so Likert form items included choices ranging from 4 (*strongly* agree) to 0 (*strongly* disagree). A few examples of the items are: *"Research in psychology is necessary to understand human behavior", "Being part of a participant pool is not useful", "I have improved my knowledge in methods in psychology due to my participation in the experiment","Participating in the experiment has been an interesting experience"*...

Student background. As it is known that prior achievement is the best predictor for actual achievement (García, Alvarado, & Jimenez, 2000; House, Hurst, & Keely, 1996; Wilson & Hardgrave, 1995), student background measures included self-reported PAU scores. PAU score is a mean of the exam access to the university and the grades obtained in High School. So, we tested before the experiment that all three groups got similar scores in the best predictor for the exam results.

Exam performance. A multiple-choice test (three response alternatives) with 16 theory and practice questions was applied to all groups. The final score could be between 0 (all wrong or no responses found to any question) and 10 (all questions correctly answered). An example of a theoretical question is: "*When we want to see the temporal stability of a given measure we are referring to: a) construct validity, b) reliability or c) content validity"*. Practice questions were based in a given experimental study case. They should respond to several questions regarding the methods explained in the study. One example may be to determine if there was an interaction according to the results of the study and to explain that interaction: "*According to the results: a) the students in the evening answer less questions regardless of the noise, b) the noise effect is higher in the morning than in the evening, c) doing a task with noise affects concentration regardless of doing it in the morning or in the evening*".

Results

Sample Differences

In order to be sure that the three groups were as equivalent as possible, we performed one-way ANOVAS on the following variables: 1) prior achievement (PAU scores); 2) estimation of self-hours of study and 3) hours of class attendance. No differences between the three groups were found ($F < 1$ in all cases) in any of the variables measured.

Therefore, all three groups were equivalent in those variables that better predict academic achievement (García et al., 2000; House et al., 1996; Wilson & Hardgrave, 1995).

Exam Performance

Final exam score was the number of correct responses, corrected by chance.

We made a one-way ANOVA with "grade of participation" as factor, finding significant differences between the groups [$F(2, 52) = 5.56$; $p = .006$; $\mu^2 = .18$]. In the Bonferroni t-tests, we found differences between NP and PP groups ($p = .01$) and between NP and AP groups ($p = .04$). No differences were found between PP and AP ($p = .64$). More importantly, the mean final scores were significatively higher for the PP and AP (PP $M = 7.60$; $SD = 1.00$; $N = 18$ & AP $M = 7.40$; $SD = 1.52$; $N = 16$) than for the NP group (NP $M = 6.10$; $SD = 1.84$; $N = 21$).

Self-reported Measures

Regarding "beliefs about psychology and research methods in psychology", we summed all the responses of the seven items for each participant and calculated the mean score for each group. Making again a one-way ANOVA with "grade of participation" as factor, we found no differences between the three groups [$F(2, 55) = 2.19$; $p = .121$].

We also calculated the mean score of the sum of the (10) satisfaction and (4) perceived learning variables only for PP and AP group (the NP group could not answer to those questions because they did not participate as research subjects in the experiments). Making a *t*-test for PP and AP groups for "satisfaction" we found no differences between the groups [$t(33) = 1.07$; $p = .29$]. However, we found significant differences between the groups for "perceived learning" [$t(34) = 2.20$; $p = .03$; $d = .74$]. The AP group ($M = 12.38$) had the perception that they have learned more than the PP group ($M = 10.75$) (*range* 0-16).

Discussion and Conclusions

It seems that research participation may be an important tool improving exam performance of our students at the university. There are significant differences between the non-participation group -NP group- (students who decided not to participate in the experiment) and the participation groups (PP and AP) regardless if the type of participation was active or passive.

Research participation may be an important experience for our students to better learn the basis of research designs in Research Methods in Psychology, based on our data. More than a higher perception of satisfaction, previously found in other works (Bowman & Waite, 2003; Briton, 1979; Darling et al., 2007; Landrum & Chastain, 1995; Rosell et al., 2005; Trafimow, Madson, & Gwizdowski, 2006), we can see in the present results that the advantage is also present in exam performance. It seems that being a part of that of what you are studying may result in an advantage of the learning results.

However, taking into account the lack of differences found between the PP and the AP group, it appears that participation in an experiment may be enough to generate differences in exam performance. We would have expected to find differences between AP and PP groups by showing better exam performance in the AP group, but it has not been the case. We required the AP group to think about those terms by elaborating a report related to the experiment such as determining dependent and independent variables, possible strange variables, to interpret the results found in the experiment in terms of interactions, etc. Moreover, we gave classes of experimental designs based on the experiment they actually run as an example to teach concepts such as dependent and independent variables, within subjects or between-subjects variables, the concept of interaction…, only to the AP group. However, the AP group had the same exam performance as the PP group, that only participated by running the experiment. One possible explanation of this result is that the students can relate those terms studied in class with the experience of being a research participant in a given experiment by themselves. In fact, as an ethical part of the process, although the teacher used their own participation in the experiment as the connecting threat in the experimental design classes only for the AP group, all students were informed about the final results of the cognitive psychology experiments (as well as the purpose of them, although nothing was said about the purpose of the results of the present study). Perhaps, all students that had participated in the experiments (both in the AP and the PP groups) may relate those methodological concepts to the experiment they actually run, regardless if they were required or not to elaborate a report about the experiment or they received classes using those experiments as examples of the terms introduced in the matter. Giving an explanation of the implication of their participation in the cognitive research could have helped them understanding Research Methods by contextualizing their "real-experience in a given psychological experiment" within the matter of study. In fact, participation may do learning experience as valuable mainly when an explanation of the experiment has been given to students (King, 1970). Thus, the PP group could have taken an advantage over the NP group by doing that active work of relating experimental terms in Research Methods in Psychology with the experiment they actually run by themselves without teacher's help (as in the AP group). Although students of the NP group were present during the explanation of the experiments, they did not take an advantage of it, probably because they could not contextualized it as a "real-experience". Indeed, in experiment 2 of Elliot et al. (2010) similar results have been found, although measuring a simple concept as we previously mentioned. Moreover, reviewing the literature of active methods in education, there are a lot of examples of how active learning (such as learning as inquiry) may help in a successfully learning of science processes (e.g., Dunbar, 1995; Falk & Yarden, 2009; Hapgood, Magnusson, & Palinscar, 2004). There are several studies that have compared different teaching methods finding better results in students' learning profits when those methods were related to a more active methodology where the students may need induction learning processes such as the case method (Ochsendorf, Boehncke, Sommerlad, & Kaufmann, 2006), cooperative or collaborative group discussions (Cheng, Rhee, Baik, & Os, 2009), problem based learning methodologies (Nalesnik, Heaton, Olsen, Haffner, & Zahn, 2004) or the use of chats, blogs or social networks as a teaching tool (Greenhow, Robelia, & Hughes, 2009; Williams & Jacobs, 2004) among others. In all those cases, the active implication of the student is more important and necessary to perform the task than in a traditional lecture. In fact, teaching and learning processes have been changed through the last years from the typical lecture sessions where the implication of the student is very low to active methods where the student has to be highly implicated in the learning process (Barr & Tagg, 1995).

On the other hand, results of self-reported tests regarding satisfaction and perceived learning of the matter of Research Methods in Psychology through their participation in the study are very similar to the results found in other studies: students are satisfied by their participation in the study, regardless they have an active or a passive participation (Briton, 1979; Landrum & Chastain, 1995; Bowman & Waite, 2003; Darling et al., 2007; Rosell et al., 2005). However, the active participation group had the feeling that they had learned more of experimental methods thanks to their participation in the experiment than the passive participation group. Conversely, the results of the exam performance are very different; differences in exam performance did not appear between those groups although

they, in fact, appeared for the perceived learning through the participation in the experiment. Perhaps, relating the learning process and the experiment run in the AP group and elaborating the report about it, made the students to perceive that they were learning more than the other students. In fact, similar results have been found using e-portfolio assessment systems in junior high school students; the Web portfolio assessment system has no significant influence on student achievement, although implementation of the Web portfolio assessment system significantly enhances self-perceived learning performance (Chang, 2008).

To finalize, we want to remark that no differences between the three groups were found for "prior achievement", the best predictor of academic achievement (García et al., 2000; House et al., 1996; Wilson & Hardgrave, 1995), so we can say that the lack of random assignment between NP and AP-PP groups was compensated. Moreover, no differences were found either for variables usually related to better exam performance such as hours of study (Diseth, Pallesen, Brunborg, & Larsen, 2010; Rau & Durand, 2000; Touron, 1983) or class attendance (García et al., 2000). On the other hand, although other variables such as motivation could have been measured, we think that they are also included in prior achievement, as part of the causes that produced the academic achievement, registered through the PAU measure. Although a motivational measure would give us a better explanation of the variability of the groups (and may be taken into account for future research), we consider that we can be highly sure that changes in exam performance may not be due to those variables that best correlate with academic achievement: previous academic performance, hours of study or class attendance.

Summarizing, based on the results of present study participation sample pools may be a powerful teaching tool for our students in order to improve learning results. We need to determine how this could be achieved in other psychological or non-psychological matters; it seems that being a participant in a certain research may help you to understand better psychological matters such as Research Methods in psychology but we cannot be sure how that could affect in other psychological or non-psychological matters. Moreover, feedback of the study in which they have participated may be an elemental tool for our students to understand not only what they are studying but also what real psychological science is doing in our universities nowadays.

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