The 8th International Scientific Conference
eLearning and software for Education
Bucharest, April 26-27, 2012
10.5682/2066-026X-12-053

THE ROLE OF EDUCATIONAL SOFTWARE IN SECONDARY SCHOOL STUDENTS' ACADEMIC PERFORMANCE

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***Abstract**: The educational software is intended to support and enhance the students' learning performances. In addition to the software's characteristics, such as scope, purpose, etc., the characteristic of the end-user student play a role in the type and magnitude of the learning effects. Moreover, whereas the effects are estimated formally by the teachers, the end-user student may still experience positive effects such as increased facility of learning. The research questions concerned the teacher-student differences and the predictive value of the computer and software usage for the facility of learning and academic performance.The study design was transversal, one-time, correlational, using multiple regressions to determine the most relevant impacts of the predictor variables on the students' academic performance. The results provide the basis for further, experimental research, to explore the direction of influence, and a basis for the teachers to better manipulate the use of educational software for their students' learning performances enhancement.*

Keywords: *educational software, computer usage, academic performance, secondary education, correlational research, facility of learning*

I. INTRODUCTION / THE ROLE OF GENERAL AND SPECIFIC SOFTWARE IN EDUCATION

An impressive amount of software was designed and marketed as educational software for primary and secondary school students. Today, there exists educational software designed specifically for a subject matter or for a more general educational purpose, aimed at enhancing a more diverse set of skills, required for multiple academic disciplines. Also, with respect to the originators of educational software utilization, it may be provided by the schools themselves or the learners, independently of the school. Its primary end-purpose is to provide additional support for learning and to elicit higher academic performance from its users. Today, the educational software evolves in very rapid pace, taking an increasingly more psychological approach to the learning processes involved. Information and communication technology tools with applicability in education include spreadshits, word processors, databases, scientific calculators, interactive whiteboards, and the modern forms include computerized drill and practice, simulations, and tutorials (IRMA, 2011). However, there is reported evidence that many parents and educators are not convinced about the benefits of using educational software or even have difficulties accepting it (Virvou, Katsionis, & Manos, 2005). Moreover, there is still scares empirical evidence as to the efficiency of educational software usage in relation with academic performance in Romanian students.

Against this current state of knowledge, we hypothesized that the academic performance is positively impacted by the utilization of educational software. Also, we considered alongside the intensity of utilization, the environment of utilization, the specificity of software, as well as the overall self-reported computer literacy of the learner. The data was collected from a sample of participants comprised of secondary education students—gymnasium and high school students. The independent (predictor) and dependent (predicted) variables were measured using self-reported measures of software utilization from the students and from their teachers, and factual data—i.e., academic grades—for the academic performance.

A series of research questions were formulated concerning the relation between the utilization of educational software and the academic effects. The first research question was whether or not the utilization of educational software bears any benefits for the students' academic performance. Also, does the type of software, i.e. specifically designed for one subject matter versus general in purpose or adequate for more than one subject matter, matter significantly in the student's overall performance? A third research question, also related to the participant students' learning was directed at discovering if those participant students who utilize specific educational software report greater facility of learning. Because it may be argued that the longer a person uses the computer, the more skilled that person becomes, we were also interested in investigating if the length of utilization of computers relates to the student's academic performance. Moreover, since the utilization of any type of software requires a specific set of skills and knowledge, we were interested in learning if the computer literacy in general correlates with the intensity of usage of the educational software; more specifically, do the students who report greater computer literacy also report higher intensity of usage in educational software? Given that academic performance, subject-matter specific or general, was assessed by teachers, who compared the participant students with their other students, we were interested in the differences between the teachers perception of the intensity of software utilization, computer literacy, and learning facility as compared with their students. Finally, considering all variables, we were interested in discovering the best predictor for the students' academic performance.

II. METHOD

2.1. Participants

A number of N = 150 participant students (78 females and 72 males) enrolled in secondary education, grades 5-12, ranging from 10 to 20 years of age, enrolled in 3 educational institutions, took part in the research. Mean age of participants was M = 14.66, SD = 2.69 (M females = 13.94, SD = 2.57; M males = 15.44, SD = 2.49)

2.2. Research design

A cross-sectional, one-time, correlational design was employed in order to extract the participants' responses. The data was further processed using descriptive and inferential statistical analyses. The raw data was processed using IBM SPSS ™ statistical software.

2.3. Measures

An 18 items paper-pencil two-sections self-reported questionnaire was designed for the extraction of data regarding the participant's demographics, the *specificity of software* used by the students, the *intensity of software usage*, the *intensity of computer usage*, the *computer-literacy* of the participant students, the *easiness or facility of learning* for both overall matters and the specific software related subject-matter, and, of course, the overall and software-specific subject-matter *academic performance*. The questionnaire had two parts, one for the students (8 items) and one for their teachers (12 items—5 demographic items and 7 computer and software usage related items), with several items (computer-literacy and facility of learning) being replicated for each category of respondents. The reason for this dual-report was to assess if there was a difference in the perception of teachers versus the students' perception for several controversial items, which we assumed would impact the teachers' evaluation of their student's academic performance. With the exception of the demographic items, all items were assessed using 7-point (pervazivity of usage), 5-point (computer-literacy, facility of learning, intensity of specific software usage, intensity of computer usage), 3-point (length of computer-usage) Likert Scales, and one categorical item which estimated the existence of specific-software usage. A teacher-estimated measure of their students' academic performance, assessed using a 5-point Likert scale ranging from 1 = very poor (as compared to my other students) to

5 = very good (as compared to my other students), was used instead of academic grades, because it was considered more objective than the formal grades—teachers had access to formal grades and incorporated this information in their assessment of the participant students' academic performance. The participant students teacher-estimated academic performance was, at times, designated as *dependent variable*—in accordance with Tabachnick and Fidell (2007) we have used the terms "independent variable (IV)" and "dependent variable (DV)" to conveniently describe the predictor (IV) and, respectively, the outcome or response variables (DV) without assuming an explicit causal relationship. Moreover, in a certain situation, the DV can become and IV. For instance, *learning facility* is treated as a DV (predicted) in relation with *computer literacy* or with *general use of computers*, but becomes IV (predictor) in relation with *academic performance*. The questionnaires were checked for construct validity by two independent experts from the Faculty of Psychology and Educational Sciences of Babeş-Bolyai University of Cluj-Napoca.

2.4. Procedure

The questionnaire was delivered and completed in a school setting, during the coordination classes, in order not to interfere with the normal teaching activities. Each group of participants, teachers and students, completed their corresponding questionnaires. The expression of voluntary participation consent was explained and included in the questionnaires.

III. RESULTS

The first research question was that if those students using educational software, be it subject-specific or general-purpose, have higher academic performances than those who do not use educational software. As such, the teacher-estimated academic performance of the educational software users showed a mean score $M = 3.73$ (trimmed to 3.76 after a 5% exclusion of extreme values), clearly above the average score of 3, at a standard deviation of $\sigma = .908$. The distribution of scores was very slightly skewed to the right (-.100). The assessment of normality using Kolmogorov-Smirnov statistic showed a non-normal distribution, quite common in large samples (Pallant, 2011).

Another research question was if those students who use specifically-tailored educational software gain any advantages in academic performances as compared with those using general-purpose software. As such, the difference in (teacher-estimated) student's academic performance between the two types of users (subject-matter specific software users versus general software users) was analyzed with a t-test of independent samples. The two subgroups of users comprised of those students who use matter-specific software and those who use general purpose software. There was no significant difference in scores for the subject matter specific software users ($M = 3.67$, $SD = .93$) and the general purpose software users ($M = 3.75$, $SD = .90$); $t\ (146) = -.50$, $p = .62$, two-tailed. The magnitude of the differences in means (means difference = -.086, 95% *CI:* -.42 to .25) was very small (eta squared $\eta^2 = .002$).

However, the covariance of the teacher-assessed academic performance with the other variables also had to be assessed. Preliminary analyses were conducted for all correlations in order to ensure no violation of the assumptions of normality, linearity, and homoscedasticity. A series of significant correlations were observed between the (teacher-estimated) general academic performance and age ($r = -.40$, $n = 148$, $p < .01$), school year ($r = -.39$, $n = 148$, $p < .01$), teacher-estimated usage intensity of educational software ($r = .38$, $n = 148$, $p < .01$), self-estimated usage intensity of educational software ($r = .17$, $n = 148$, $p < .05$), self-estimated general usage of computers ($r = .19$, $n = 148$, $p < .05$), teacher-estimated computer literacy ($r = .30$, $n = 148$, $p < .01$), and self-estimated computer literacy ($r = .32$, $n = 148$, $p < .01$). The Spearman's rho statistic was computed and significant correlations were observed between the (teacher-estimated) general academic performance and the variable of gender (*rho* = .23, $n = 148$, $p < .01$), residence (*rho* = -.18, $n = 148$, $p < .05$). No significant correlations were recorded between the (teacher-estimated) general academic performance and the (self-estimated) time of usage and between the (teacher-estimated) general academic performance and the pervasivity of computer utilization.

The difference recorded in the Pearson-moment correlations between the teacher-estimated computer-literacy and the teacher-estimated general educational score, on the one hand, and the self-estimated computer-literacy and the teacher-estimated general educational scores, on the other hand, raised an additional question concerning the significance of this difference in perception, which was assessed using a paired-samples test for the comparison of means. No significant differences were recorded (N = 150, M = -.093, p (2-tailed) = .166). Also, the observed differences in the teachers' perception of their students' educational software usage intensity and the students' own perception regarding the software usage was assessed using a paired samples test No significant difference in perception of teachers, as compared to the perception of their students regarding the intensity of usage was recorded (N = 150, M = .060, p (2-tailed) = .258).

We were also interested in the correlation between the educational software usage intensity and computer literacy. Whereas the teacher-estimated computer literacy of their students correlated significantly, albeit weakly, with the teacher-estimated educational software usage intensity in their students (r = .25, n = 150, p < .001), the participant students' own estimation of computer literacy did not show significant correlation with the self-estimated usage intensity of educational software (r = .10, n = 150, p = .226).

Another effect of the educational software usage that constituted a research question concerned the facility of learning, which was assessed using both teachers' perceptions as well as the participant's own perception regarding the facility of learning, for both the entire learning process and for the learning at those matters corresponding to the subject-matter specific software. An independent-samples t-test was conducted for teacher-estimated general subject matter facility of learning, self-estimated general subject-matter facility of learning, teacher-estimated specific subject-matter facility of learning and self-estimated specific subject-matter facility of learning. No significant differences were observed regarding the facility of learning (both assessed by the teachers and the participant students themselves, and both regarding the general learning facility and the subject-matter specific learning learning) between the users subject-matter specific software and the users of general purpose educational software.

However, further discriminant analyses focused on finding the differences between the participants and their teachers' perception regarding the perceived facility of learning. Regarding this matter, another analysis concerned the correlation between the teacher-estimated academic performances and the teachers' and their students' facility of learning, both for general learning processes and for the subject-matter specific software learning facility. The results showed that the teachers have a stronger tendency to associated high levels of (teacher-estimated) general academic performance with high levels of both general facility of learning and subject-specific facility of learning than it was the case for their participant students.

Paired-samples tests were employed, for both general facility of learning and for the subject-matter specific software facility of learning and, whereas for the estimation of general facility of learning, there are no significant differences between the teachers' and their students' perceptions (N = 148, M = -.142, p (2-tailed) = .060), the perception of teachers and students differ significantly with respect to the subject-matter specific software facility of learning (N = 148, M = -.220, p (2-tailed) = .003).

As stated in the beginning of this paper, we were interested in discovering the strongest predictors for the academic performance. A total variance R^2 = 61%, p < .001, F (13, 102) = 12.395, in the teacher-estimated general academic performance was explained by all other variables (age, general computer usage, educational software usage, computer literacy, and facility of learning). However, from all variables considered only the (self-estimated) general use of computers (β = .23, p < .01, partial η^2= .08), the teacher-estimated subject-matter academic performance (β = .34, p < .01, partial η^2= .04), and the teacher-estimated general learning facility (β = .40, p < .01, partial η^2= .16) had unique contributions. According to Tabachnick and Fidell (2007), η^2 is considered small at around .01, medium at around .09, and large at around .25.

With respect to the teacher-estimated subject-matter specific academic performance, a total variance of R^2 = 65%, p < .001, F (13, 102) = 14.488 was explained by all other variables. However, from all variables considered, only the self-estimated general use of computers (β = -.18, p < .05, partial η^2= .02), the teacher-estimated subject-matter facility of learning (β = .51, p < .01, partial η^2= .08), the teacher-estimated general learning facility (β = -.21, p < .05, partial η^2= .02) and the teacher-estimated general academic performance (β = .31, p < .01, partial η^2= .04) showed significant predictive values, with the self-estimated general learning facility coming close at a p = .066, which, in social sciences, given the large number of subjects, is worth considering in future research.

Partial correlation was used to explore the relationship between the (teacher-estimated) general academic performance and the (teacher-estimated) software-specific subject-matter academic performance, while controlling for scores on all other variables. Preliminary analyses were performed in order to ensure no violation of the assumptions of normality, linearity, and homoscedasticity. There was a medium, positive, partial correlation between the general academic performance and the software-specific subject-matter academic performance, controlling for other variables, r = .37, n = 104, p < .001, with higher levels of general academic performance being associated with higher levels of software-specific subject-matter academic performance. An inspection of the zero order correlation (r = .59) suggested that controlling for the other variables had a significant effect on the strength of the relationship between these two variables, diminishing it by approx. 39%. The significant regression pathways, together with the relevant partial correlations, are presented in Figure 1, bellow.

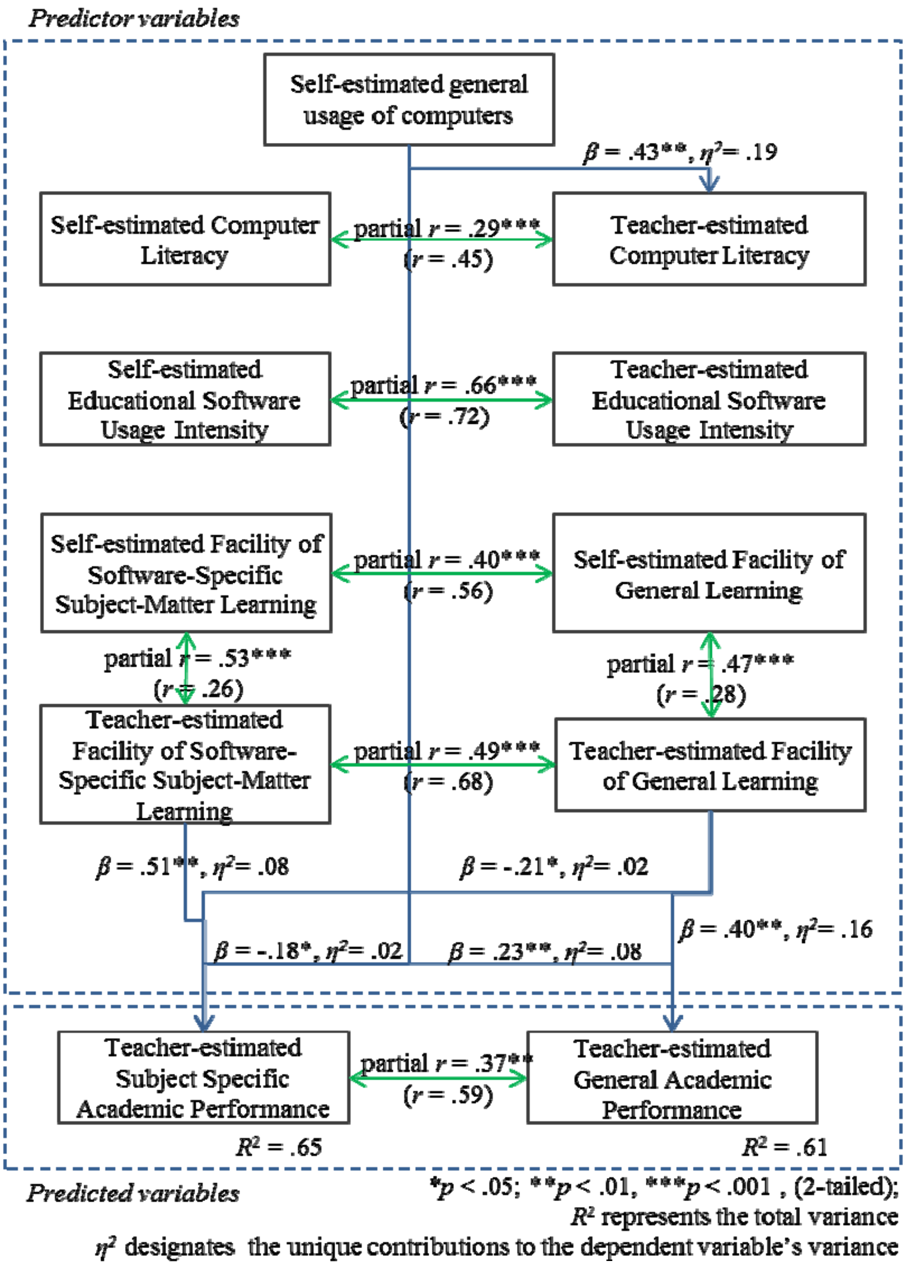

Figure 1. Conceptual model incorporating the hypothesized influence (regression) pathways for the (teacher-estimated) academic performance of the participant students.

IV. DISCUSSIONS

In relation to our original research questions, several results concerning the perceived facility of learning and the variance of teacher estimated general and specific academic performance are especially important. It is also important to note that time of usage, that is the length of time since the participant students started using the computers, and the pervasivity of usage, that is the number of places in which they use the computer, didn't show any significant predictive value, either for the facility of learning or for the academic performance.

Facility of learning

Whereas there was no significant difference between the teachers' and the students' perception of general education facility of learning, this changed with respect to the software-specific subject-matter facility of learning, with students reporting statistically significant higher facility of learning for those matters for which they use specific software than their teachers have perceived. However, it is important to observe that the higher the teachers' perception regarding the facility of learning for subject-specific matters, the higher is their assessment of the student's performance. This suggests that a reconciliation between the student's perception of the subject-specific facility of learning with their teachers' corresponding perception would increase their academic evaluations. More specifically, the effects on the learning facility as a consequence of educational software usage could be improved, the gap between the students' and their teachers' perception of learning facility could be reduced, and, as consequence, more students could have their facility of learning resulting in higher academic evaluations by their teachers.

The conceptual model

A feasible model of influence pathways was developed using partial data. The results showed a positive correlation between the software utilization with educational purposes and the academic performance, regardless of the age or the school level of the user. More importantly, the best predictors for the teacher-estimated academic performance, either software-specific subject-matter or general, are the teacher-estimated and the self-estimated facility of learning. The effect sizes ranged from small (the case of teacher-estimated facility of general learning predicting the software-specific subject-matter academic performance, to large for the teacher-estimated facility of general learning predicting the general academic performance). Whereas not all variables could be fitted completely in the model and not all influence pathways could be developed, a large proportion of the total variance in subject-matter and general academic performance was explained by the model.

The relevance

The relevance of the study for the Romanian educational research resides in its novelty as well as in the development of the conceptual model. Furthermore, the study may have benefits for teachers, in their quest for enhancing their students' performance via the use of educational software. The limitations of the study, residing in its one-time, transversal, correlational nature require further research to identify eventual differences among school-based and home-based use of software is needed, as well as for clarifying the role of additional variables in interplay between educational software usage and academic performance. A longitudinal follow-up on the students' academic performance evolution in relation with the educational software utilization would provide further insight in the stability and the validity of the hypothesized influence pathways.

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