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| RESEARCH ARTICLE

Probing the Role of Writing Tasks in Furthering Self-directed, Self-Corrective Problem-Solving Skills among Undergraduate Students

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| ABSTRACT
Problem-solving skills are of paramount importance in university education, and they are used as some of the salient parameters to gauge learning outcomes. In this vein, this quasi-experimental study seeks to assess and evaluate the relationship between the writing tasks that college students perform in class and their higher-order thinking skills such as critical thinking and problem-solving (PS) skills. The chief concern of this article is to find out to what extent problem-solving skills, including analysis, evaluation, explanation, and deduction, among university students can be expedited through writing tasks aimed at addressing and tackling problems and obstacles facing students on campus. 196 students from the College of Applied Studies at Al-Kharj (CASK) in Saudi Arabia are the subjects of this study. The subjects were split at random into two groups: control group (n=98) and intervention group (n = 98). The research method used was both quantitative and qualitative. Students in the two groups took a pre-test and a post-test. The researchers assessed the PS skills against the Facione and Facione (1994) scoring parameters. The findings show that there is a strong connection between writing tasks on topics of problems and obstacles and PS skills. The statistics showed a significant improvement in PS skills among the intervention group as opposed to the control group in analysis, evaluation, explanation and deduction. This study recommends that more research be conducted on the correlation between writing tasks aimed at addressing problems/dilemmas and other higher-order thinking skills.

| KEYWORDS

Boosting and evaluating, college students, problem-solving skills, writing skills

| ARTICLE INFORMATION

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1. Introduction

Problem-solving (PS) skills are now considered of paramount importance in tertiary education. These skills are not inborn, but rather universities can help students acquire them and improve them through practice (Işıklar & Abalı-Öztürk, 2022). PS skills can be manifested in a variety of cognitive performance tasks, such as analysis, evaluation, explanation and deduction (Facione, 1990; Ennis, 1985). However, Willingham (2008) argues that PS skills can only be specific to a particular domain and that they cannot be transferred volitionally to other domains or contexts.

Despite this controversy over the transferability or non-transferability of PS skills, the present study aims to question the earlier opinions, which posited that PS skills are transferable and can be improved and augmented through classroom training and practice. In support of the earlier views is the fact that those earlier studies made it clear that PS skills are measurable, and they provided scoring rubrics for the evaluation of the level and complexity of PS skills (Facione, 1990).

Critical thinking, and by extension PS skills for purposes of the present study, can be assessed by means of either of four different tests. The "California Critical Thinking Skills Test" is one of those, and it assesses the subskills of critical thinking (Facione, 1990).

The "Cornell Critical Thinking Test" gets the test takers to use methods of thought that are inductive and deductive through a multiple-choice format test (Plath et al., 1999). The "Ennis-Weir Critical Thinking Essay Test" is "a flexible test that requires the subjects to produce and appraise arguments (Ku, 2009). The "Watson Glaser Critical Thinking Appraisal", explained in detail in Bernard (2008), is the fourth type of test for assessing critical thinking skills such as problem-solving, and it uses multiple-choice questions to measure "inference, recognition of assumptions, deduction, interpretation and evaluation of arguments."

In the present study, The Facione (1990) "Delphi Report" was adopted as the essential method for measuring PS skills. In this report, the skill of problem solving is defined as "purposeful, self-regulatory judgement that results in interpretation, analysis, evaluation, inference and planation of the evidential, conceptual, methodological, criteriological or contextual considerations upon which that judgment is based." Later studies (e.g., Dwyer et al. 2014), seem to recognize and support the Delphi Report.

A scoring rubric for PS skills was developed by Facione and Facione (1994) that they called "the Holistic Critical Thinking Scoring Rubric". This tool can be utilized in marking students' writing assignments, and it provides a number of directions that elucidate how it can be used. It gauges PS skills using 6 main capabilities: "interpretation, analysis, evaluation, inference, explanation and self-regulation." This rubric needs to be used by a minimum of two judges, and assesses writing compositions on a 4-point scale: weak (no sign of PS skills), unacceptable (poor PS skills performance), acceptable (some PS skills) and strong (a wide array of PS skills).

Guiller et al. (2008) state that it Bolstering PS skills in tertiary education is not a luxury but a necessity. Despite this, PS skills do not seem to have received enough attention in college curricular (Reed & Kromery, 2001). From their personal experience teaching writing courses among others at CASK, the researchers have seen that students have performed below par in their writing composition tasks when they do not use PS skills in their writings. Therefore, the present study aims primarily to encourage and evaluate PS skills in writing courses and to investigate the connection between writing on problematic issues and PS skills. The significance of this paper stems from its endeavour to unravel the connection between writing and PS skills and the potential to help students improve their PS skills through writing. The present study probes the following research questions:

RQ1: What is the connection between PS skills and argumentative writing tasks?

RQ2: What are the educational, cognitive benefits of encouraging argumentative writing for skills in analysis, evaluation, explanation and deduction?

2. Method

2.1 Participants

This study used a sample of students from CASK. The total number of students was 196, and they were all freshmen, enrolled in different programmes of study such as Occupational Health and Safety, Recreation and Tourism Management and Multimedia. All students were taking subsidiary English courses as college requirements. One of those courses was Writing. The sample was split into two groups: control group (n=98) and intervention group (n = 98). The participants were randomly placed in four different writing classes, with an average of 50 students in each class. The researchers tried to get as many students as possible in the study. The number of volunteers (196) was considered adequate for the present study.

2.2 Instrument

2.2.1 Teaching material

As is the custom in research, the intervention group had to be taught using a specific teaching material. In this study, that material was obtained from one of the course references for further study: "Critical Thinking: A Student's Introduction," by Bassham et al. (2010). This book was selected because it encompassed nearly all the essentials of PS. The group took eight lessons aimed directly at dealing with PS skills. The control group, however, did not take any classes targeting PS skills.

2.2.2 Scoring Rubric

For assessment purposes in the present study, the Facione and Facione (1994) "HCTSR" was a helpful tool for a number of reasons. First, this rubric stems from and impinges on the Delphi Report, and also because this Report was used by professors to evaluate students' performance in writing courses. Moreover, the HCTSR has the ability to assist in assessing the learners' writing skills in terms of analysis, evaluation, explanation, argumentation and deduction.

2.3 PS Skills Training

For the intervention group, lessons were prepared that aimed to directly address issues and problems that could be solved only through PS skills. The course lasted for 12 weeks, three 50-minute classes per week. The teaching material was taught in two stages. Stage one was the teaching stage. At this stage, two weekly classes (a total of roughly 100 minutes) were given for the purpose of teaching the students the PS skills. These classes involved teaching PS skills both directly in a lecture type style and also indirectly by means of untraditional tasks during classes such as role-play, demonstration, group discussions, debates, etc. Stage two was

carried out individually in the third weekly class. The learners were prompted to write essays that tackled a problem and had to suggest tenable, down-to-earth solutions to the problem.

The writing activities carried out in these classes were multifarious both in terms of scope and complexity. The initial tasks would start easy, tackling straightforward, easily soluble problems, and move on to more heavy-going tasks that necessitated sophisticated solutions and in-depth analysis. As for the control group, they received regular classes without any PS skills instruction or training provided.

2.4 Validity and Reliability

To ensure validity of the instrument, seven experts were consulted. They examined the instrument meticulously, and then they gave insightful comments and suggested some edits. The researchers made changes in unison with their recommendations. Moreover, prior to this study, a pilot study was conducted that involved 44 students; this pilot study was carried out in order to perform inter-rater reliability and to ensure that the content and technique is useful. The students in the pilot study were not included later in the actual study. The same content and procedure that was going to be used in the study was used in the pilot study, and the same faculty member carried out both the pilot study and the actual one. Having conducted the pilot study, the researchers were now confident that the material and the procedure were fit for the study and that no further changes or modifications were needed.

As for inter-rater reliability, four raters – the faculty member involved in the study and three external – held a workshop and discussion sessions. Each rater coded 25 writings in the pilot study, and then the ratings were compared. The researchers used the Cohen Kappa instrument to determine inter-rater reliability, and it was 0.76, 0.75, 0.83 and 0.72. The same procedure was repeated in the actual study, and inter-reliability scores were 0.79, 0.72, 0.81 and 0.77. Those results showed an adequately high inter-rater reliability.

2.5 Procedure

First and foremost, a pre-test was conducted. Both the intervention and control groups had to take it. The aim of the pre-test was to make sure that the two groups were more or less "on a level playing field" in terms of their PS skills before they started. The test asked the test-takers to compose an essay made up of at least four paragraphs (around 250 words in length) in which they had to discuss and suggest solutions to the car-parking space problem on campus. The subject of the essay was especially appealing because it addressed a real-life problem that the participants experienced almost on a daily basis. After the pre-test, the course instructor met the intervention group students and explained to them and discussed with them the course content, the procedure, and to respond to any queries they might have. Subsequently, the course started, and each week the students had to run in one essay tackling a problem and suggesting practical solutions to the problem. Each writing task involved three steps:

Pre-writing: a topic was assigned, and the students were told to research that topic in their own time outside the classroom time and gather as much information about it as they could find. In the first class of every week, students received a lot of instruction on writing and PS skills. Then some class time was allocated for the students to learn the new lesson and the new skills needed specifically for the writing topic at hand. The students were also allowed some time to hold discussion groups and exchange ideas between them.

Drafting: a model essay was presented, and the students were asked to read it ruminatingly and then set about composing their own essay on the same topic, guided by the model essay and the PS skills they had just been taught.

Post-writing: the students were asked to swap essays amongst themselves and peer-review each other's essays. They gave each other feedback. Once that peer-review step had been completed, they were now instructed to edit and revise their essays before handing them in to the professor.

The essays in their final version were marked by the course instructor and the researchers. They also made comments in annotations and returned copies of the essays to the students. This procedure, which involved formative assessment, helped the students immensely as they learned from their mistakes and ameliorated their PS skills substantially with every new writing task. At the close of the training phase, all students in both the intervention and control groups took the same posttest.

2.6 Data Analysis

The students' writings were examined and analysed by the professor and the researchers using the "HCTSR". The writings were graded on a scale from one (meaning mediocre) to five (meaning outstanding). All the writings from the pre-test, post-test and the weekly assignments were coded each on its own by the raters. Whenever there were clear gaps in the scorings of the writings, further discussions between the raters were held to resolve the incongruity and to agree on a unified middle ground between them.

Utilizing the scoring rubric in the course textbook "Introduction to Academic Writing", the researchers and raters assessed the writings turned in by the students. the writings received scores based duly on 5 parameters: syntactic structures, punctuation, organization, arrangement and content. After that, the researchers utilized the SPSS to calculate the elicited data.

Following this treatment phase, the researchers analysed the quantitative data statistically for the purpose of evaluating the differences in using and applying PS skills amongst students in the two groups. For the purpose of pinpointing variations between the intervention and control groups, the SPSS method was used to calculate the means (M), standard deviation (SD), frequencies and one-way ANOVA. Any values below 0.05 were ignored because statistically they did not have much impact on the results.

3. Findings

The researchers made a comparison between the Ms and the SDs of PS skills and writing skills between the two groups prior to start of the course in order to ascertain a reliable equivalency between the two groups. As for PS skills, the intervention group obtained M = 2.03 and SD = 0.609. The control group scored M = 2.01 and SD = 0.701. As for skills in writing composition, the intervention group scored M = 45.05 and SD = 17.01. The control group scored M = 44.9 and SD = 17.03. The researchers then did the one-way ANOVA to find out whether the differences were suggestive, as shown in Table 1.

Table 1

Pretest writing and PS skills results, one-way ANOVA

	Writing Skills					PS Skills				
Source	Sum of Squares	df	Mean Square	F	Sig.	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.367	1	.367	.001	.970	.010	1	.010	.020	.888
Within Groups	4015.633	96	250.163			48.898	96	.509		
Total	24016.000	97				48.908	97			

As Table 1 shows, initially there were no significant differences in terms PS skills between the students in the two groups. For the writing skills F = 0.01, and for the PS skills F = 0.02. This shows that the learners in both groups were on the same "level playing field" prior to the commencement of this study.

To address RQ1, the Pearson Correlation was calculated between the totals of the posttest results for both variable items: the writing composition acumen and PS skills. The calculation yielded results that were positively connected with statistically significant values. The resultant correlation from that calculation was 0.687, and at level 0.01 that is highly significant.

For RQ2, the researchers computed the Ms and SDs on writing skills and PS skills. The M scores attained by the students in the intervention group exhibited palpable variation in terms of PS skills (M = 3.03, SD = 0.76), whereas the control group attained much less significant scores (M = 2.01, SD = 0.701). As with respect to writing skills, the intervention group again exhibited palpable variation (M = 58.54, SD = 13.85), whereas for the comparison groups the mean scores were (M = 51.77, SD = 13.81). Table 2 shows how one-way ANOVA demonstrates the significance or otherwise of the differences in the scores.

Table 2

One-way ANOVA scores of writing composition and PS skills

	Writing Skills					PS Skills				
Source	Sum of Squares	df	Mean Square	F	Sig.	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.367	1	.367	.001	.970	.010	1	.010	.020	.888
Within Groups	24015.633	96	250.163			48.898	96	.509		
Total	24016.000	97				48.908	97			

As is shown in Table 2, one-way ANOVA demonstrates statistically significant variations in PS skills for the pre-test and post-test (F = 6.158, p = 0.13), and also for the writing composition skills (F = 5.644, p = 0.17). translating the numbers into words, it is apparent that applying this study to the intervention group resulted in a substantial improvement in both their writing acumen and PS skills.

4. Discussion

With regards to RQ1, it is obvious that there was a strong positive connection between PS skills and writing proficiency. This finding is in unison with those from former studies (e.g., Hu, 2017; Fahim & Hashtroodi, 2012), which demonstrated a positive influence of writing tasks on critical thinking. Hu (2017) posits that "writing asks for more critical thinking skills, and in turn, writing is a proper media for teachers to develop students' critical thinking skills."

The literature suggests ebulliently that writing tasks in the classroom boost and expedite PS skills in students. the literature also suggests that when learners receive intensive training in PS skills, they eventually acquire more in-depth concepts and progress in their ideas on topics that are of a problematic nature and need to be resolved, and this in turn also helps the students ameliorate their writing acumen. Dixon (1996) posits that it is of paramount importance to give students intensive and continuous training on PS skills in order for the students to be able to showcase their PS skills through their argumentative essays.

With regards to RQ2, which addresses the educational and cognitive benefits of argumentative writing in advancing and burnishing PS skills, it should be noted that improvement in PS skills and writing skills happened in both groups. But evidence from the statistics, however, shows that the students in the intervention group were a lot better at utilizing PS skills when they composed their writings, particularly in analysis, evaluation, explanation and deduction. It is assumed that the marked progress in both groups and not only in the intervention group was ascribable to the fact that both groups had been enrolled in the writing course and were immersed in its content for the duration of a whole semester.

The analysis skill was the first PS skill to be assessed. It showcased progress in both the intervention group (72.55%) and the control group (56.2%). According to Quitadamo and Kurtz (2007), the practice of argumentative writing skills improves PS skills substantially, in contrast with students who do not practise writing at all. Facione (1990) defines the analysis skill as being able to "identify the intended relationships among statements, questions, concepts, descriptions… to express beliefs, judgments, reasons,… or opinions." For example, student A shows a clear understanding of the interrelatedness of the data that were pivotal to presenting his opinion. The quotation below from his writing shows that he had looked into the idea presented to him, pondered over it, and then produced an understandable, consistent, and rational view on the topic. The thesis statement of his writing is unequivocally presented in paragraph one, and following that statement is a brief account of how the piece of witing is about to be formulated.

> *Student A: I think that the problem of inadequate parking space on campus is causing disruptions to classes and exams. It is making it difficult for students and also for faculty members to attend classes punctually, and during exam times, many students come to the test room too late.*

Student B showcased vivid understanding of the topic and inalienable ability to analyse it. He was able to find out the connection between two sides of the argument, as shown in the below excerpt from his essay. He even identified a few assumptions that were not stated in the writing task instructions, such as that the parking space problem can be a blessing in disguise.

> *Student B: The inadequacy of parking space on our university campus is a serious problem, but it is also a positive thing in some ways. For example, it forces students to come to college bright and early in order to secure a parking space for their vehicles.*

The second skill to be examined was evaluation. This skill is defined as the ability "to assess the credibility of statements… and the strength of the relationships among statements, descriptions, questions or other forms of representation" (Facione, 1990). The skill of evaluation encompasses "assessing claims and assessing arguments" (ibid). The statistics showed a growth in PS skills in both groups: the intervention group 78.66%, and the control group 62.15%. clearly, the statistics again show a marked increase in the intervention group as opposed to a lesser increase in the control group. These statistics can be interpreted to mean that the learners benefited significantly from the writing tasks in ameliorating their skill of evaluation. As mentioned earlier, evaluation involves assessing claims and assessing arguments. Student C, in the excerpt below, demonstrated a credible amount of evaluation skill as he assessed the reliability of the claim, and he also assessed arguments:

> *Student C: I think that I cannot but agree with the idea that inadequacy of parking space on campus is deleterious to the classes in some ways.*

This excerpt shows that this student reasoned the claim and decided it was factual. Therefore, he provided a supportive re-statement that powerfully propped up the claim that the inadequacy of parking space on campus was causing disruptions to the

classrooms. Moreover, as he composed his thesis statement, he assessed arguments and made it clear that he strongly agreed with the claim: "I cannot but agree".

The third skill to be assessed was explanation. The statistics unequivocally show that the students from the intervention group got the better of those in the control group in the explanation skill. In the intervention group, 82.72% of the students scored 4 or higher out of 5 in their writing tasks, as opposed to 61.15% in the control group. Facione (1990) identifies the explanation skill as the ability "to state the results of one's reasoning; to justify the reasoning, and to present one's reasoning in the form of cogent arguments." The three key words in Facione's definition are: stating, justifying and presenting. In the excerpt below from an essay from student D, the student presented a situation, he related his opinion, and then he stated the result.

> *Student D: Besides, the inadequacy of parking space on campus can have adverse effects on the students' morale. In my opinion, students are likely to lose impetus when they find it hard to be accommodated properly on campus. This not only affects their studies negatively, but it also leaves a negative impression on them in the long run.*

The last skill to be assessed in the present study was the skill of deduction. Consistent with all previous statistics and results apropos of the dichotomy between the intervention group and the control group, again the intervention group fared better than their counterparts in the control group in terms of the deduction skill. In the intervention group, the score for the deduction skill was 74.66%, whereas for the control group it was 54.22%. Facione (1990) identifies the deduction skill as the ability "to consider relevant information and to deduce the consequences. It includes the sub-skills of querying evidence, conjecturing alternatives and drawing conclusions."

In the excerpt below from an essay written by student E, the student demonstrates an ability to conjecture alternatives, which is one of the sub-skills of deduction. Student E agrees that the inadequacy of parking space is deleterious to classes and hampering exams, and then he provides alternatives that can alleviate the problem substantially.

> *Student E: Because the insufficiency of parking space is a complicated issue that cannot be fixed easily, and because sorting out this problem can be very costly, we may need to look for alternatives. I think we can launch a car-pooling project like they do in other countries. By this I mean several students share one car instead of each student coming to campus in their own car. This means a lot fewer cars on campus.*

In this other excerpt below from student F, tenable conclusions were drawn at the close of the essay, which is one of the three sub-skills of deduction. The student outlines the possible consequences if the problem of parking space persists, and he predicts further problems to arise in future if the problem lingers on unsolved.

> *Student F: For those many reasons I have discussed, it is apparent that the inadequacy of parking space on campus is disrupting classes and exams, and it is making college life for students unbearably tedious. Unless this problem is addressed soon, it will continue to cause jampacked parking in which cars get stuck and students sometimes cannot move their cars because the parked cars are too close to each other, getting in each other's ways. Unless fixed soon, this problem will make some students consider transferring to other colleges and universities in nearby cities.*

4.1 Limitations and Future Research

A few limitations can be noticed in the present study despite the fact that it has obviously some advantageous knowledge and statistical analyses to add to the literature. Firstly, the population of the study was confined to a sample taken from CASK. If similar studies were conducted on students in other universities in other countries and the results were compared, this would add scope and breadth to the literature. In addition, this study took into account the definition of PS skills and their sub-skills in Facione (1990). There are some other definitions from different angles in the literature, and they may be worth probing to see how the results would compare to the results of the present study. Last but not least, the present study used participants from the college for men; no females were involved in the study. Therefore, a study involving both genders should be interesting as it may reveal different or comparable results. This study recommends that further research may be carried out on the correlation between writing tasks aimed at addressing problems/dilemmas and other higher-order thinking skills.

5. Conclusions

The statistical analyses of the present study show that there is a strong connection between writing tasks on topics of problems / obstacles and PS skills. A significant improvement in PS skills among the intervention group as opposed to the control group was observed in the higher-order thinking sub-skills of analysis, evaluation, explanation and deduction.

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